POPULAR SCIENCE

FOUNDED MONTHLY 1872

SEPTEMBER

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SEE PAGE 47

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3. *Wall Brackets:* 15 to 25 watts for decorative lighting. 60 watts on each side of the bathroom or dressing table mirror. For kitchen, 40 to 60 watts.

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FOUNDED MONTHLY 1872

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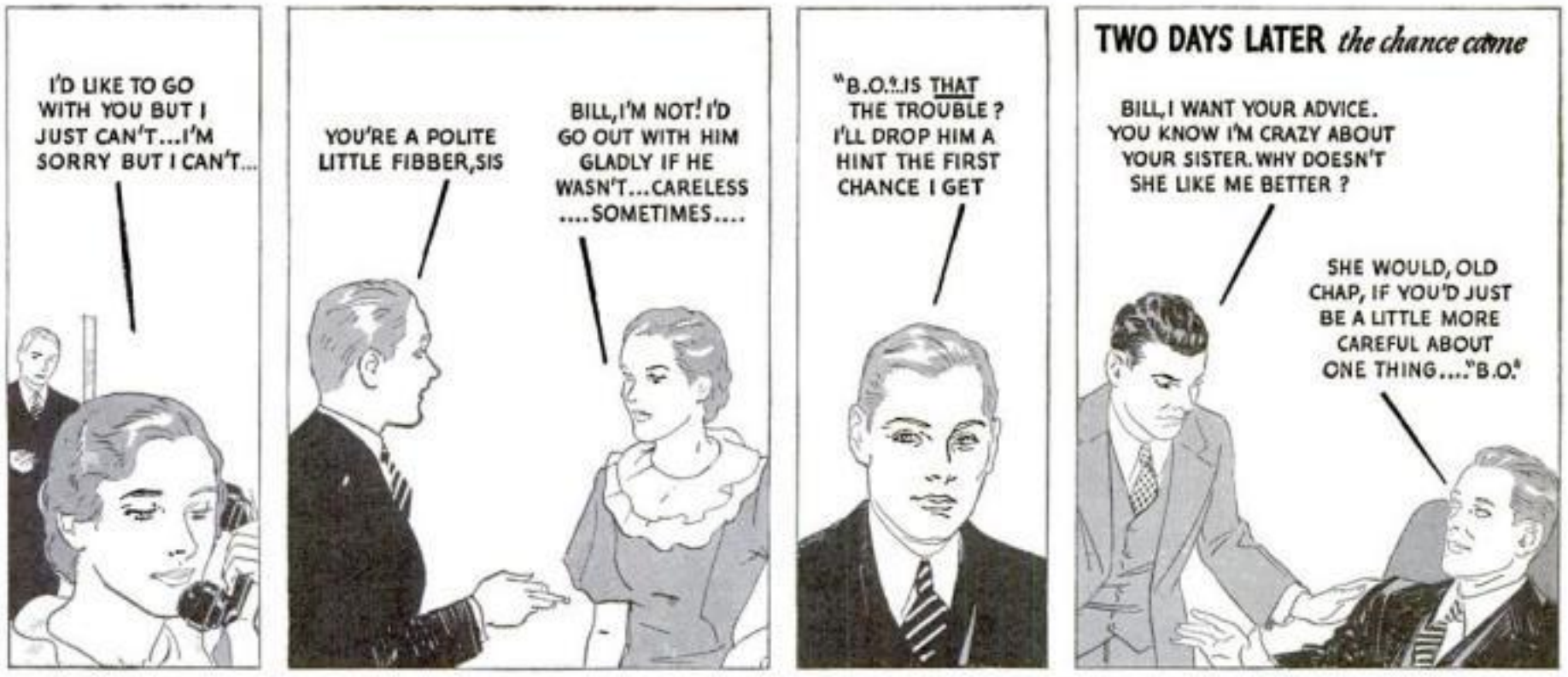
FEATURES AND DEPARTMENTS

Cover design by EDGAR F. WITTMACK

AUTOMOBILES

AVIATION

BROTHER BILL PUTS HIM WISE



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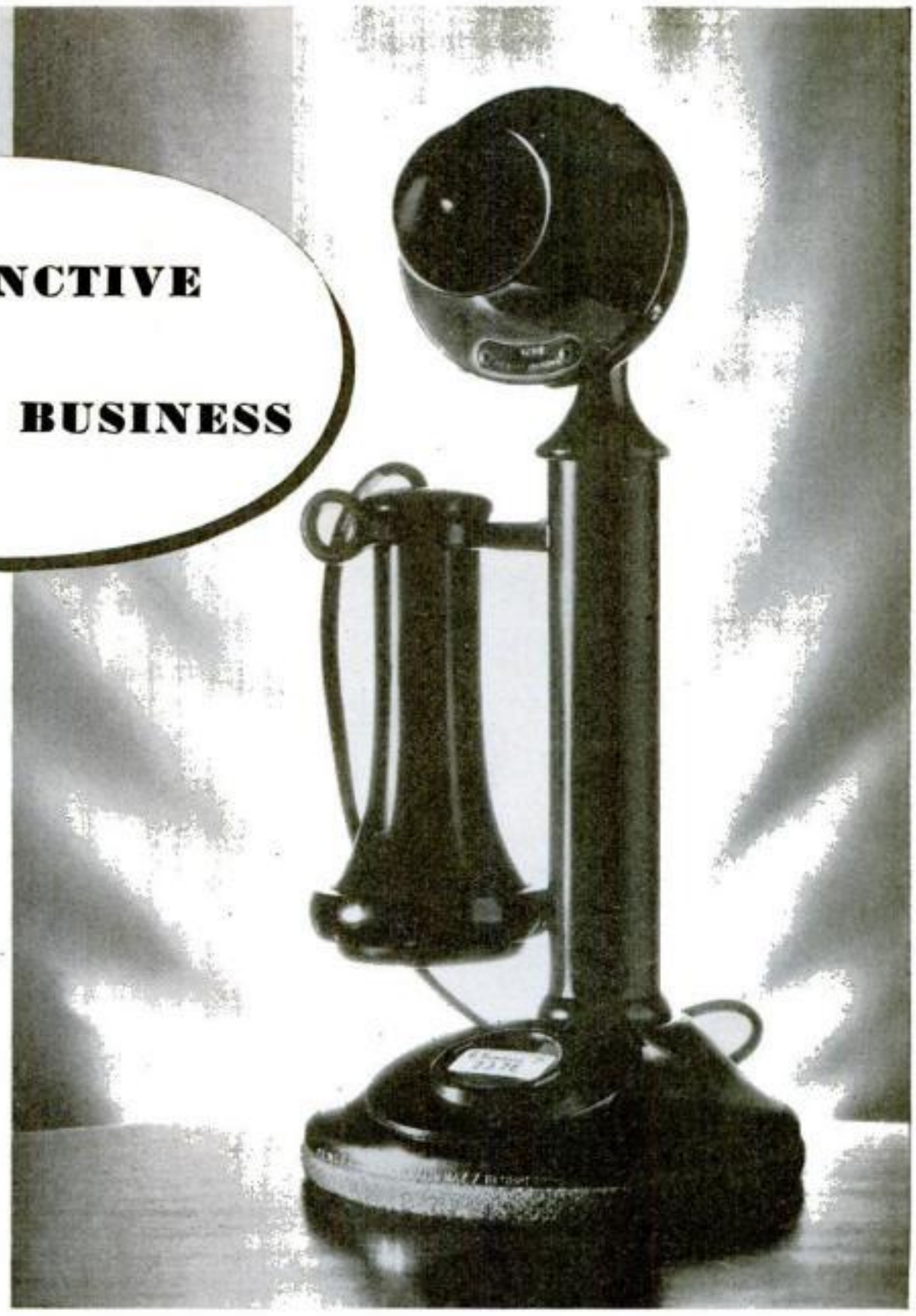
POPULAR SCIENCE MONTHLY FOR SEPTEMBER, 1934

In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

A DISTINCTIVE AMERICAN BUSINESS

The Bell Telephone System is operated in the interest of the public



THE Bell System is a widely owned organization operating a public service under federal and state regulation.

Its threefold purpose is to give the public the best telephone service at the lowest possible cost, give steady work at fair wages to its hundreds of thousands of employees and pay a reasonable return to the men and women who have invested in it.

The constant endeavor of the management is to deal equitably and honorably with each of these groups. There is no reason to do otherwise. There are 675,000 people who own the stock of the parent company—American Telephone and Telegraph. They are the owners of its nation-wide property. They are your neighbors. They live in every state of the Union and their average holding is twenty-seven shares. No individual or organization owns as much as one per cent of the stock.

In the truest sense, the Bell System is a business democracy—born in America, brought to its present stature by American enterprise, financed and operated by and for the people of America.

BELL TELEPHONE SYSTEM

Asbestos sheet tiling is easily applied by any home owner with the simplest of tools

Modernize your Bathroom

By R. M. Bolen

Secretary, Popular Science Institute

This modernized bathroom has asbestos tile wainscoting and is floored with rubber tile

NOVEL materials now make it a simple matter to modernize an old-style bathroom. Drab plaster walls can be covered with a new, easily applied tile, and dust-catching wood floors can be hidden under a bright covering of linoleum or rubber.

When glazed clay tile was the only long-wearing material available for bathroom walls, few amateurs attempted the work. Real tile was both expensive and difficult to apply. Now, however, various forms of imitation tiling have entered the remodeling picture and modern methods of construction have brought the job entirely within the scope of any one who can handle simple tools.

From the standpoint of low cost and ease of construction, a new composition asbestos sheet tiling is perhaps best suited to the needs of the home owner who desires to do the work himself. Manufactured in large sheets, it can be cut to shape with an ordinary handsaw and fastened to the old walls with nails.

Asbestos tiling of this type is both sturdy and easily cleaned. Under normal conditions of heat and moisture, it has been found to compare favorably with clay tile. This fact, coupled with the simple manner in which it is applied, makes it entirely practical for the amateur to build a stall shower simply by partitioning off a corner of a large bathroom, providing it with a waterproof floor and drain, and finishing the walls with panels of tile.

As to the cost of applying asbestos tiling to bathroom walls either ceiling-high or as a wainscoting, the materials can be bought for approximately fifty cents a square foot, while the labor, if an outside contractor does the work, will run about twenty cents a square foot. When figured on the basis of $1.50 per square foot for real clay tile laid in place, this represents quite a saving. In fact, the upkeep as well as the initial cost will be lower for asbestos tile since the surface will neither crack, chip, nor drop out.

A recently developed porcelain enameled steel tile also lends itself well to remodeling work. Made in colorful units resembling clay tiles, this type of wall finish is fastened in place with strong metal clips. Each tile is placed separately by snapping it onto a special clip board nailed to the wall surface or studding. To complete the tiled effect, a bond of regular cement is forced into the space between adjacent units. This type of tiling is particularly sturdy and easy to clean, yet it costs thirty per cent less than the

clay tile which must be cemented in place.

When remodeling a bathroom, the floors as well as the walls should come in for special consideration. Wood floors are neither sanitary nor good looking. Besides, they can be concealed with a covering of long-wearing linoleum or rubber tile. Both are inexpensive and have the advantage of being easily cleaned.

A linoleum floor, imitating either tile or marble, can be laid for about two dollars a square yard. Rubber tile, on the other hand, will cost just about twice as much for the same area.

Although linoleum is often laid by merely tacking it under narrow brass binding strips, a better looking job will result if it is cemented in place and supplied with a base of linoleum felt. The felt should be cemented to the floor and the linoleum in turn cemented to the felt. The cement used should be of the waterproof variety sold for the purpose.

A RUBBER floor, although more expensive and harder to lay, will be well worth the additional cost and labor. It will wear longer than most floor coverings and has the added advantage of being both soft and warm.

Available in a variety of colors and textures, it is sold in large sheets as well as in four, eight, and twelve-inch squares. By combining the two, a two-color diamond pattern edged with a solid color border can be obtained. The presence of the border will offer a means of adjusting the combined size of the tiles used to the total area of the floor to be covered.

Like linoleum, rubber tiling also requires a base of felt. This should be laid first and every precaution taken to make it smooth. If portions tend to bulge, they can be held in place with small tacks to reinforce the cement. The second step is to lay the border and finally the individual tiles. Since each tile is laid separately. the cement should be applied to the back side of the rubber and the tile slid into place. Finally, the floor should be rolled with a rolling pin and allowed to set.

With the present low prices of porcelain wall and ceiling lighting fixtures, no home owner can afford to miss the opportunity to modernize his bathroom lighting equipment. Wall brackets having plug outlets as well as shaded lamp sockets can be obtained for less than a dollar while white globe ceiling units can be bought for a bit more.

A new tile of porcelain-enameled steel is put on with wire clips, as shown in this diagram

Our Readers Say

See Data on the Experiment of the Kilkenny Cats

HERE is a problem that has been bothering me for a long time. Although it is evident that this could not actually happen, it is a type of problem which, from a scientific standpoint, can be considered to have a definite result. Three snakes, equal in every respect, take hold of one another's tails with their mouths, forming a circle. At the same time and rate each begins to swallow the snake in front of it, starting with the tail. Imagining that the snakes continued to live, what would become of them? Would they disappear completely? If one digested another, what would become of the remains? Under the principle of conservation of matter something must be left at the end. What this is I leave to the readers of POPULAR SCIENCE MONTHLY.—D.L., New Rochelle, N. Y.

Microscope Reveals Model for Polka Dot Necktie

WHILE looking through my microscope just a few minutes ago I was profoundly puzzled by the sudden appearance of a strange animal, plant, or what-have-you, which I had never seen or heard of before. It appeared to be absolutely transparent except for twelve bluish-green dots which seemed to be held together by invisible protoplasm. It seemed to be rolling along in the water and always the twelve dots appeared to stay in the same relative place. At one time I saw three of these things in the field of the microscope. The water I was looking at came from an indoor aquarium to the sides of which some algæ had become attached; I scraped off some of these algæ and was looking at them when I found the strange organisms. They may have been colonies of germs or they may have been some strange new animals. If some better-informed reader can set me right on this matter I shall be grateful.—E.A.T., Jr., Charlotte, N. C.

The Kid-Brother Menace Gets Tardy Recognition

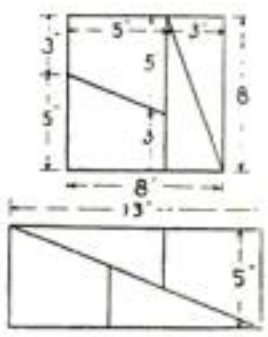
EVERYTHING that M.P., Brooklyn, N. Y., said in a recent issue, about your publishing articles on X-ray machines and induction-coil apparatus, goes for me, too. Not only that, but we want instructions for an electric-eye apparatus that will protect the house from thieves and personal belongings from younger brothers. The radio department has aroused my interest in that field and I'd like a hook-up for a good automobile radio. Tell G. P. K., Cleveland Heights, Ohio, that he's nerts with his magic ring trick.—W. B. S., Richmond, Va.

A Philatelist Makes the Retort Courteous

JUST a word to F. H. S., of Bangor, Me. I believe his idea about stamps not being a science is all wrong, and I base my contention on this point: If a person did not have any idea about science, I would not advise him to save stamps because he could not tell a fake stamp from a genuine one. With all the stamps that are being issued today, it is hard enough for the expert stamp collector with all his chemicals to tell a true stamp from a bogus one without making a hit-or-miss matter of it. I hope you will publish this letter so that F. H. S. will know just what a stamp collector thinks of him and his statement.—G. D., Jamaica, N. Y.

Where Do We Get the Extra Square Inch?

I AM submitting a problem my father gave me years ago. He was a millwright and fond of problems of this kind, but he never managed to solve this one. I have tried it on mathematicians and college professors, and none of them has given me a satisfactory answer. How about some of the Einsteins of Our Readers Say? Cardboard can be used in making the pattern, and to insure accuracy all measurements should be made carefully. Mark off a square exactly eight by eight inches, as in Fig. 1. Make the four three-inch measurements, mark off as indicated by heavy lines, and cut out with a sharp razor blade. The pieces can be placed together in an oblong, as in Fig. 2. The square, of course, had an area of sixty-four square inches, while the oblong measures five by thirteen inches and therefore has an area of sixty-five square inches. The question is, where do we get the additional square inch of area without adding any material? Some say it is due to the space between the lines, but I do not think so. I have had the pattern cut out very accurately in thick sheet brass by a machinist, with allowance made for the thickness of the lines, and there is still the same difference in area between the two figures. How do you account for this?—C. C. B., Los Angeles, Calif.



Well, L.M.G., Here's Your Nocturnal Rainbow!

THE letter of L. M. G., of Lewistown, Pa., with reference to rainbows at night, reminds me of an experience I had recently. I was spending the Easter holidays at Woy Woy, on the Hawkesbury River about forty-eight miles north of Sydney, Australia. On my way to a dance at night, I was surprised to see a rainbow in the clouds. This was at 7:45 p.m. and it was quite dark. The rainbow was in the west, while the full moon was rising in the east. The rainbow was not of various colors, but all a pale blue and was reflected perfectly in the waters of the river. I know of about six other people who saw the same phenomenon that night.—G. S., Sydney, Australia.

Under This System We'd Get Our Mail by Degrees

IN A recent issue of POPULAR SCIENCE MONTHLY you have a scheme for addressing mail with reference to imaginary lines criss-crossing the country. Wonderful! But why not use the lines we already have—the parallels of latitude and meridians of longitude? Then our postmasters and carriers would only have to study astronomy and some navigation rules so that they could "shoot the sun" and figure out the desired locations.—O. L. F., Columbus, Ohio.

Another Humiliation for the Father of Waters

AN IDEA to prevent the annual floods that are so destructive and costly to our country: Near the mouth of the Mississippi, giant water wheels could be constructed, stretching part of the way across the stream. As the water rises the wheels are set in motion and accelerate the flow of the current enough to keep the river and its tributaries from overflowing their banks. In time of drought the wheels could be turned in the opposite direction to slow the current.—F. W. B., Chicago, Ill.

This Should at Least Make Jury Duty More Popular

I HAVE an idea that concerns motion pictures and law, and may be worth something. When an attorney sums up his case for trial, his object is to present it in such a way that the court and jury can see a picture of what he is talking about, a life picture of what really happened. Now, wouldn't it be much easier, more convincing, and more expressive, if he could put his case before the court and jury in the form of real, live characters—a motion picture right there in the courtroom? He could explain his vital points afterwards, or with the talkies he could have a commentary right in the picture. Every attorney could have a scenario writer on his staff, if he is unable to write his own scenario, and actors and actresses at his call whenever a big case breaks. With the director and scenario writer he could characterize his case and produce the events under discussion as he thinks they occurred. I real-

ize that it would be hard for an idea of this kind to work smoothly at the beginning, but eventually it could be made into a big thing. It means more work all around, too. Not long ago I heard an attorney addressing a jury say, "I wish to heaven I could show you with motion pictures what I am trying to impress upon you!"—L. C. M., Salt Lake City, Utah.

Reader Says Sea Serpent Is Just an Elasmosaur

A STUDY of the bones and museum reconstructions of the elasmosaur, a species belonging to the latest age of reptiles, should clear up the mystery of the "sea serpents" seen in many parts of the world. In your May issue you published a photograph of the creature cast up on the shore of France, and although this specimen was somewhat damaged there is no doubt that it was an elasmosaur. These reptiles were once very numerous in North America and their remains have been found in all parts of the world. Their heads were poised on necks from ten to twenty feet long, which would make them appear very much like serpents when swimming. For legs they had paddles which enabled them to swim rapidly through water or make progress on land. They did not chew their food but swallowed it whole, "gizzard stones" found with their remains indicating that their digestive organs were like those of birds. The descriptions of the Loch Ness "serpent" and those seen in Canada, with their "sheeplike heads attached to long necks and barrel-like bodies," agree with the elasmosaur and with no other creature in ancient or modern times. The actual finding of the body of one on the French coast proves for a certainty that some of these creatures still exist in the modern world.—J. B., Toronto, Canada.

Volunteer Fireman Wants To Modernize the Bucket Brigade

At some time in the future I should like to see some articles on fire apparatus for small towns. Such equipment must be cheap, as the average small town hasn't much money to spend and nearly everything must be done by volunteers, both the actual work and the raising of the money. After a fire in our town (population 100, fifteen miles from Minneapolis), a few of us got together and raised a little money through the business men and those who wished to donate. We got 300 feet of ¾-inch garden hose, two dozen ordinary water pails, and four ladders. When there was a fire this equipment was loaded on a truck. Later we bought an old Model T car, removed the body, and attached another frame to make a trailer. This winter we bought a 1½-inch rotary pump, slow speed, and hooked it up directly to the Model T engine. We have three ¾-inch outlets and can throw a fair amount of water (if we have the water to throw). At any rate, it's better than the old way of fighting fires with bucket lines. However, we had a hard time finding out the proper pump to put on, and even now we do not know whether we have the right one. An article on the various kinds of pumps, and what they will do, would be of help to us and, I believe, to others of your readers in smaller towns who have the same problem. —E. R. S., Hamel, Minn.

An Armistice Is Declared in the Battle of the Bees

I HAVE taken my own advice, "Do a little intensive studying," as flung back in my teeth by C. H. P., Canaan, Conn., and find to my dismay and horror that he has me overbarreled when he says that worker bees are females whose generative organs are undeveloped. He's right there, but I find that I have a perfect right to call a worker bee a "neuter" if I feel like it. The Encyclopedia Americana, published in 1931, says of workers that "though also known as neuters they are, in fact, females whose generative organs have atrophied." A fellow citizen of C. H. P's in Connecticut, namely, Charles Henshaw Ward of New Haven, says in his "Evolution for John Doe" that "the big males have no stings, but they are found on the neuters, which are undeveloped females." This book was published in 1925. Also, Webster's International Dictionary, 1930 edition, gives this definition of the word "neuter": "An imperfectly developed female of certain social insects, such as ants and bees. A worker." These books certainly weren't written a hundred years ago, and they haven't discarded the word "neuter", as C. H. P. seems to think. This gives us both a chance to leave the field of battle with a few bleeding but not mortal wounds, so I think it's time we ended this controversy and turned the space we've been hogging in Our Readers Say over to some other guy who hopes to break into print.—E. C. B., Sioux City, Iowa.

A Word of Warning for Careless Chemists

I WAS much surprised that E. G., Grand Rapids, Mich., couldn't find out why alcohol burns when dropped on chromic acid. The so-called chromic acid he used was undoubtedly chromium trioxide ($Cr O_3$) and not the true chromic acid, which is very unstable and has the formula $H_2 Cr O_4$. Chromium trioxide is a very powerful oxidizing agent and alcohol dropped on it is oxidized or burned. Oxidation and reduction take place when $Cr O_3$ reacts with sugar, oxalic acid, paper, cork, sulphur dioxide, stannous chloride, arsenous oxide, ferrous salts, etc. There is no mystery about the reaction E. G. observed but if all the amateur chemists follow his example many new and surprising things may be discovered, including the fact that the hospital quota will go up. I am also an amateur chemist but I have learned to be careful in making compounds that are unstable, explosive, or violently active. However, if you must mix things that don't go safely together, just to see what will happen, use small quantities and you will only blow off a few fingers instead of wrecking the whole neighborhood.—E. W. K., Cleveland, Ohio.

No Problem Can Get This Math Shark's Goat

F. G. C., Myrtle Point, Ore., presented an interesting problem concerning two goats, as follows: "A circular inclosure, having a diameter of forty feet, has a straight fence tangent to it. At the point of tangency, two goats are tethered on opposite sides of the point of tangency. One goat has a rope fifty-four feet long. How long must the rope of the other goat be, so that their combined grazing area measures 3,112.2 square feet?" I shall not attempt to explain my theory of the solution to the general reader, as it involves dealing with calculus, but the mathematicians of the page will be interested in a brief outline of the various steps. First, the grazing area on the left side is found by determining the angle (in radians) that the radius of the circle makes in touching the point of tangency and the end of the rope. The area of the field on the left is found to be 1,312.5 square feet, and by subtracting this from the total grazing area of 3,112.2 square feet, we find that the area of the grazing field on the right is 1,799.7 square feet. Reversing our former process, we find the angle formed by the radius on this side and finally the length of the rope, which is sixty feet. Because of an error of five-place logarithms, this value may not be exact, but I would say that the error does not exceed a fraction of one per cent of sixty feet.—C. E. F., Tacoma, Wash.

Upside-Down Photography Gets Pictures Going and Coming

TAKING pictures with an eight-millimeter movie camera from the observation platform of a train, I got tired of seeing the scene running away from me on the screen. Since I could not get up on the cowcatcher of the locomotive, I took the pictures upside down from the observation platform at the rear. Due to the fact that there is only one sprocket track on the eight-millimeter projection film, it has to be turned end for end so as to keep the sprocket track on the same side, while the face of the film is reversed toward the projector.—A. L., Seattle, Wash.

This Marks the Beginning of a Shortage of Cats

I HAVE read with great interest your articles on surgery and enjoyed them a lot. It seems to me that many of us would like to try our hand at this branch of science. Why not have an amateur dissection department? This is a great branch of science and truly deserving of some consideration by the magazine editors.—M. G., New York City.

By This Time, Everybody Has Got Their Number

AN ARTICLE debunking the "science" of numerology as practiced by radio and newspaper quacks would save many potential suckers a lot of hard-earned money, don't you think?—A. V., New York City.

Let's Give Puss a Latchkey and Be Done with It

I WAS interested in the article by H. S., New Rochelle, N. Y., in the July POPULAR SCIENCE MONTHLY, about pets being able to get into their homes when they wish. He may be interested to know that some one else thought as he does. For several years we have had a connection between our doorbell and the window sill so that when our two cats stand on a stool beneath the window and place their front paws on the sill, the bell will ring. One cat always stands on the stool, but the other will reach over from a seat at the side of the window. Neither will ring if there is already somebody at the window to see them. The fun it gives us and our friends is more than you can imagine, and the cats certainly get service, day or night.—M. C. W., Springfield, Mo.

PROOF BY YOUR TEMPERATURE GAUGE!

It's easy to prove for yourself the *cooling* qualities of Ethyl. Watch your gauge when you are pushing your car along on a torrid day. See how the needle keeps well in the safety zone, regardless of speed and road conditions. Play safe! The hotter the day, the more you need Ethyl!

Ethyl contains sufficient lead (tetraethyl) to make it the world's quality motor fuel.

NOW is the time of year when the danger of your car's overheating is greatest. The most common reason for overheating is that *less* of your gasoline's energy goes into power and *more* is sent as waste heat into the cooling system. That's because the *knock*, inherent in gasoline, is at its worst in summer.

The Ethyl fluid in Ethyl Gasoline maintains the right balance. By preventing harmful knock, it keeps your motor running coolly and sweetly on the most sweltering days. That in turn protects your oil, keeps the temperature lower *inside* your car and prevents the serious and costly damage that overheating so frequently causes.

Pretty cheap protection when you realize that Ethyl now costs only 2¢ a gallon over regular gasoline—less, on the average, than $1 a month! Next time get Ethyl!

THE HOTTER THE DAY THE MORE YOU NEED IT

POPULAR SCIENCE Monthly

SEPTEMBER 1934 VOL. 125 No. 3

RAYMOND J. BROWN, Editor

Would YOU join a Mob?

By PRESCOTT LECKY

AT THE University of Iowa, a student recently burst into a psychology classroom. Dramatically he gave details of a local kidnaping and cold-blooded murder. The criminal had been caught, had confessed, and a mob was forming near the county jail to lynch him. How many would go along and help the lynchers?

At the height of the excitement, 200 students answered the following questions: How many would participate with the mob? How many would go along as spectators? How many would stay away?

In this spectacular manner, Prof. Norman C. Meier and two associates staged a test as part of extensive researches now being conducted in mob psychology. The student who brought the news acted the part so realistically that virtually the entire class was deceived. The results of the experiment give an illuminating picture of what the average citizen is likely to do if he finds himself near a forming mob.

If guilt is certain, according to the tests, sixty-six out of 200 people will take an active part. Sixty will go along as spectators. Approximately eighty will remain away. Thus, out of a group of 200 people of better than ordinary education, more than 120 will rush out to join or watch the mob.

What characteristics will these 120 have in common? Why will they act as they do? Would YOU join a mob?

Such questions, in view of recent outbreaks of mob violence, are occupying the attention of psychologists. Last year twenty-eight human beings were victims of mob murder in the United States. This is the peak figure for seven years. More than 5,000 people, many of them later proved innocent, have been lynched in the fifty-two years since 1882, nearly 500 of them since the World War.

One of the important things psychologists have discovered is that you can't measure susceptibility to the mob spirit in terms of education or intelligence alone. In highly cultured communities as well as in backward ones, mass violence may make its appearance. An example of the kind occurred in a town in Texas.

With two colleges, twenty-seven churches, and twelve city parks, this community is known as "the Athens of Texas." Yet, a few years ago, its citizens for fourteen hours were raging savages who battled Texas Rangers and National Guardsmen and finally burned a man alive!

Three times, the mob charged the courthouse where a negro prisoner, George Hughes, had been placed in the steel vault of the District Clerk's office for safekeeping. Then a woman hurled a rock through a window. Two seventeen-year-old boys poured a five-gallon can of gaso-

Below, a scene of violence that occurred recently when police dispersed strike pickets. It is incidents of this kind that can inflame solid citizens through the influence of mob suggestion and lead to acts of which no individual, working by himself could conceivably be guilty

In the picture above, the fury of the mob in action can be clearly seen. It was taken during an attack upon the jail at San Jose, Calif., and illustrates mob psychology

line through the opening and a man tossed in a lighted match. In five minutes, the building was a mass of roaring flames. Howling outside, the mob cut the fire hose as fast as it was attached to the hydrants and the prisoner was burned alive in the vault in which he sought protection.

Nor was that all. Hardly had the embers begun to cool when men with acetylene torches and dynamite cut and blasted their way into the vault to obtain the body of their victim. Placing it on a truck, 2,000 men, women, and children paraded through the streets for nearly an hour. Still not content, they finally hanged the body from a limb, piled broken boxes and boards beneath, soaked them in kerosense, and applied a match.

"Texans," said the Houston Post, editorially, "will share the astonishment of the outside world at this exhibition of lawlessness. It defies apology—almost defies explanation." Yet the evidence shows that this barbarous spectacle might happen in almost any community.

What is the explanation? The answer goes back hundreds of thousands of years, back to the days of primitive men and the belief in creatures that were not human—demons, witches, and devils of fiendish power.

Virtually every case of mob violence grows out of the same thing: a crime so revolting to the moral sensibilities of a large number of people that it stamps the criminal as devoid of human feeling and makes him appear a fiend or devil.

In the Texas case, the prisoner had confessed to attacking an elderly woman. In other instances, mob murders grew out of such depraved crimes as burning a whole family alive, beating out the brains of a defenseless old man, murdering a nine-year-old child who offered the killer all the money she had, a nickel, if he would not harm her. Contrary to general opinion, only sixteen percent, less than one out of five, of those lynched have been accused of crimes relating to sex.

The subconscious feeling that it is dealing with something beyond the pale of humanity, with a devil in the form of a man, accounts for the excesses of the mob. There is no feeling of guilt, no remorse at killing a human being. Members of the mob see themselves not as fiends and savages but as heroes ridding the world of something that has no right to live. The psychological heritage of countless generations demands the destruction of devils.

The curious, almost unbelievable, truth is: a mob murder is a moral crusade.

A few months ago, when Californians lynched the kidnapers of Brooke Hart, the papers reported a significant incident. After battering down the jail doors with huge iron pipes, and before they dragged the two prisoners from their cells to be stripped and hanged, members of the mob knelt in silent prayer.

This paradox would be inexplicable but for an understanding of the moral mainspring that actuates the crowd in its excess of violence. It must be appreciated if we are to understand how normal people lose themselves in the savage cruelty of a mob.

In time of war, a similar attitude prevails. Moral scruples against killing fellow men are stilled by the feeling that the enemy is a devil capable of any atrocity. You remember during the World War stories of how Germans were cutting off the hands of Belgian babies and boiling up the bodies of slain soldiers to obtain fat for soap making? Such falsehoods stirred up ingrained feelings descending from an age of demonology, feelings that devils must be destroyed. So in a mob. The crimes of which the victim is accused are repeated over and over. The consequence is that all emotions of compassion disappear and no extreme of punishment seems too great.

In one case where a man was burned alive, leaders of the mob were preparing to hang him when a member on the outskirts of the crowd began reciting in a high-pitched voice the awful details of the crime of which he was accused. Repeated over and over again, they had a hypnotic effect upon the crowd, driving it into a frenzy. Chaining the prisoner to a stump, it poured gasoline over a pile of faggots and turned him into a writhing human torch. As soon as the embers were cool, members rushed in like madmen, hacking the stump and breaking up the chain to obtain treasured souvenirs of the fiendish action.

Only the ancient belief in devils and the feeling that a devil cannot be tolerated but must be brutally removed from the earth, can explain such an act. This and the moral mainspring behind mass violence give an insight into the action of mobs in the mass. But what about the individual? Why does he act as he does? Why does he do things in the mob he never could, conceivably do alone?

Everyone's suggestibility mounts when he enters a crowd. A recent battery of

Mob violence demonstrated by a fight between police and a crowd during a Minneapolis riot

tests made at one American university shows we are three times as likely to accept suggestions without criticism in a mob as we are in normal life. This gives the key to the manner in which ideas spread as though by contagion through an excited crowd.

It is this element of suggestibility that explains the abnormal action of the individual in a crowd. Hypnotism is heightened suggestibility in which the subject does whatever he is told. Something like hypnotism occurs in a crowd. Ideas are accepted without criticism and acted upon without reflection.

An example is the lynching of the "Santa Claus bandit" in the Southwest a few years ago. On Christmas Eve, Marshall Ratliff, dressed as a Santa Claus, robbed a bank and killed two policemen at Cisco, Texas. He was sentenced to death, won a sanity hearing, and while awaiting test in jail feigned paralysis. A guard, thinking him helpless, entered his cell. Ratliff leaped on him, snatched away his gun, shot him dead, and made an unsuccessful attempt to escape.

The next evening a mob of enraged citizens dragged him from his cell, paraded him through the streets, and started to string him up on a telephone pole. The rope broke just as it jerked him from the ground. Fifteen minutes later, a grass rope had been made. Then, according to newspaper reports, just as he was being hauled into the air a second time, the leader shouted: "Maybe he wants to talk!" The men let go of the rope and dropped him to the ground again. Then somebody else shouted: "He doesn't want to talk," and immediately the suggestible crowd jerked him into the air for a third and last time, ending the savage exhibition.

These boxes of different sizes weigh the same. In suggestibility tests the subject, if suggestible, always thinks the big box weighs the more

The records of psychology contain numerous curious instances of this kind showing the power of suggestion.

A few months ago, for example, an eastern chemistry professor tried an experiment on his class. He held up a vial labeled "Violet Perfume" and asked the students to raise their hands as soon as they could detect the odor. Fifteen seconds after he had removed the cork every hand in the front row was up and in less than a minute three-fourths of the class had signaled they could smell the perfume. The bottle contained nothing but water.

A doctor reports an even stranger incident from his medical practice. A man and his wife were bitten by a pet dog. The man was sure he was going to develop hydrophobia; the woman was sure she wasn't. In three days, the man was sick in bed, his throat muscles were becoming taut and he complained of difficulty in swallowing. His wife was up and well.

At the end of five days, the man reported all symptoms of hydrophobia and when a week had gone by the attending physician saw he was actually on the verge of dying from a disease he didn't have. Finally, on the eighth day, the doctor convinced him nobody with hydrophobia ever lived more than six days. He jumped out of bed and soon was as well as before the dog bit him.

Most amazing of all is an instance that occurred in London, Eng. An excitable, high-strung young woman was brought to a hospital for the removal of two small tumors of the scalp. In the operating room, at the last moment the anesthetic was found to be exhausted. While attendants rushed to bring a fresh supply, the nurse in charge placed the inhaler over the patient's face to accustom her to the feel of it. Immediately, she began to breathe rapidly and in a few moments an arm that had been lying across her chest dropped to her side. By pinching it, the nurse discovered she was completely unconscious, overcome by an imaginary anesthetic.

One of the tumors was removed without any evidence that the patient felt the pain. Then the nurse tried an experiment. Removing the inhaler, she said to the surgeon: "I believe she is coming to." The patient began to stir and show signs of reviving. When the inhaler was replaced, *(Continued on page 107)*

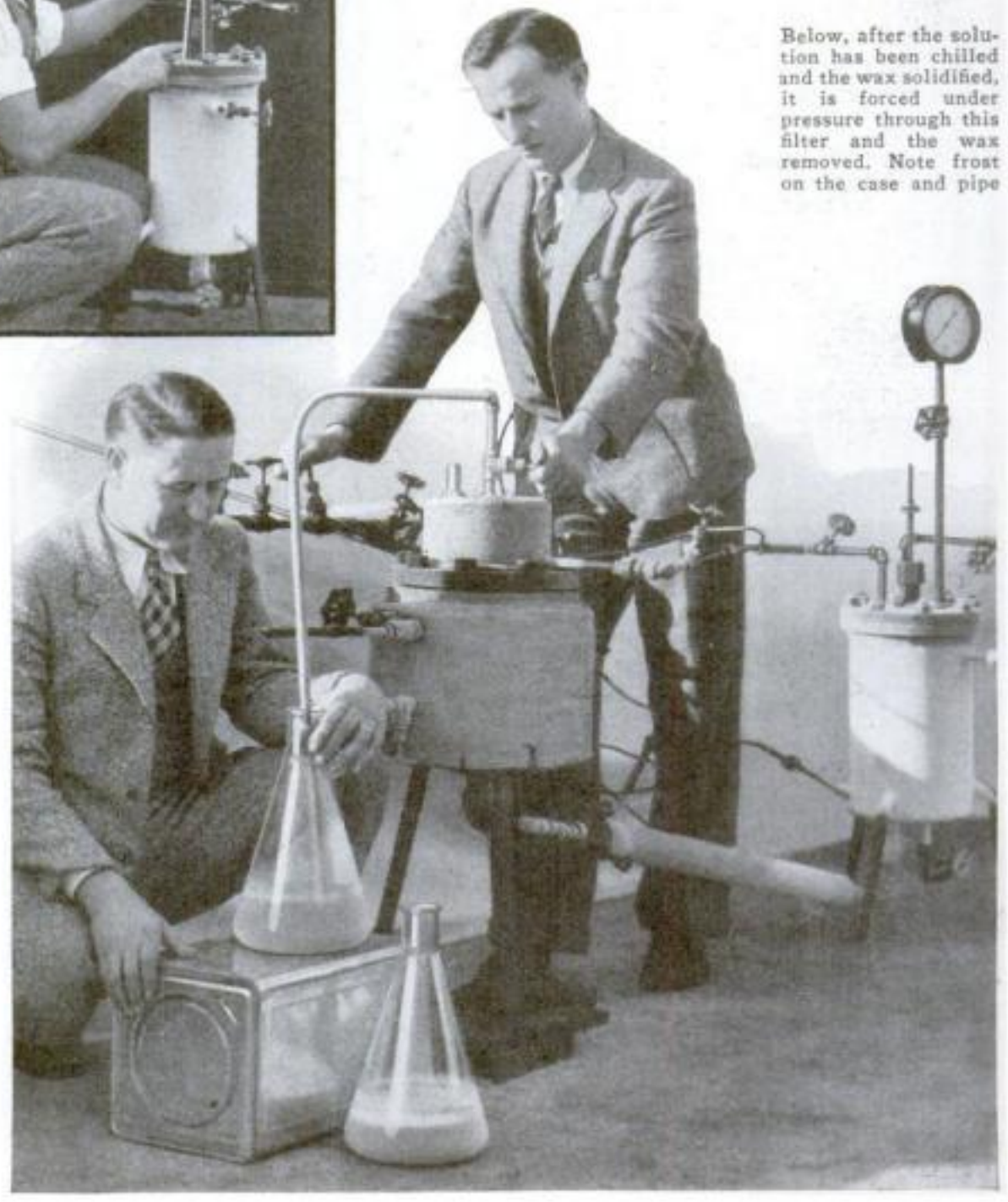
This unusual photograph taken during a riot, shows clearly the emotional fury on the mobsters' faces

Six Autos, in Perilous Run,

Propane solution of oil and wax is being transferred to lower container in which it is chilled to forty degrees below zero to solidify the wax content

Left, container in which the wax and oil solution is chilled. Releasing pressure causes propane to evaporate rapidly and freezes the wax. Above, in sixty days this car was driven 60,183 miles in a practical test of oil

Below, after the solution has been chilled and the wax solidified, it is forced under pressure through this filter and the wax removed. Note frost on the case and pipe

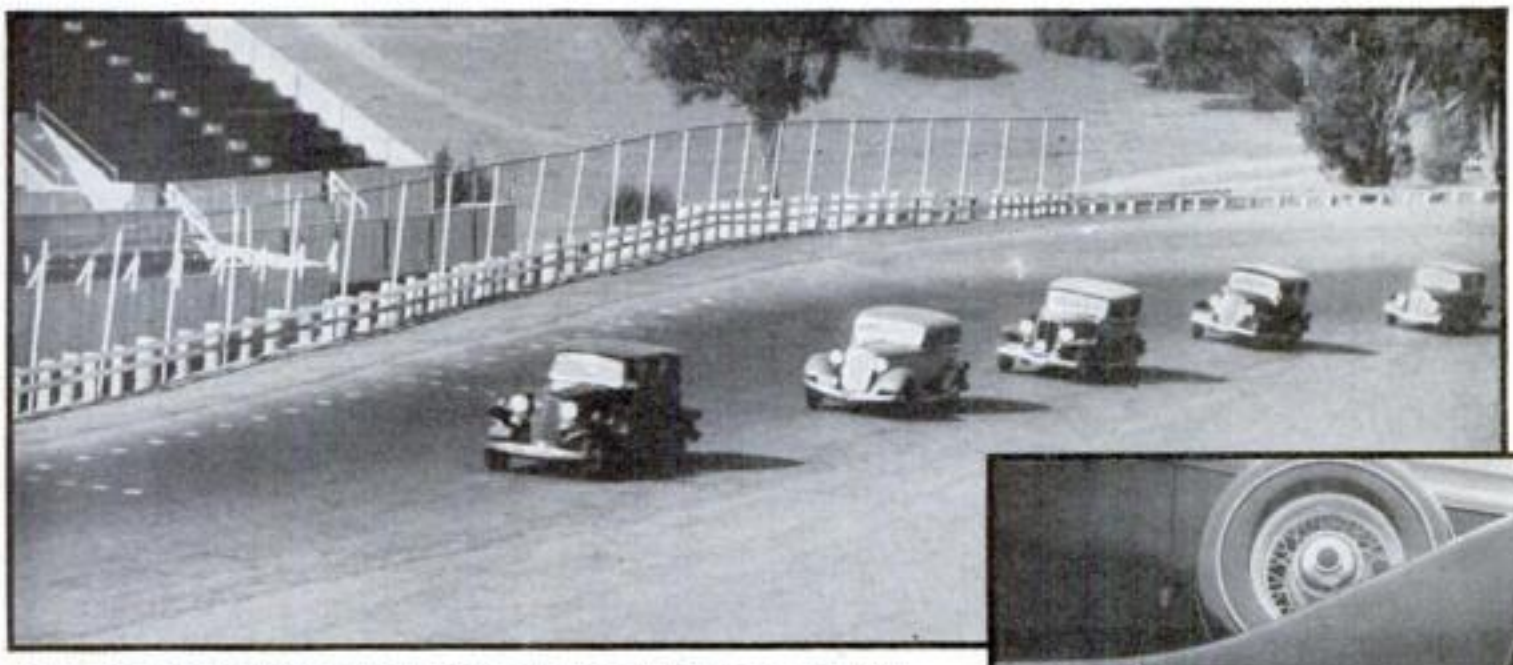


ROARING across dusty deserts and toiling over snow-covered mountain peaks, an automobile shuttled back and forth between the Mexican and Canadian border for two danger-fraught months. Night and day five other cars whirled unceasingly around a track near Los Angeles, Calif. They were the mechanical guinea pigs in one of the most grueling series of tests ever conducted.

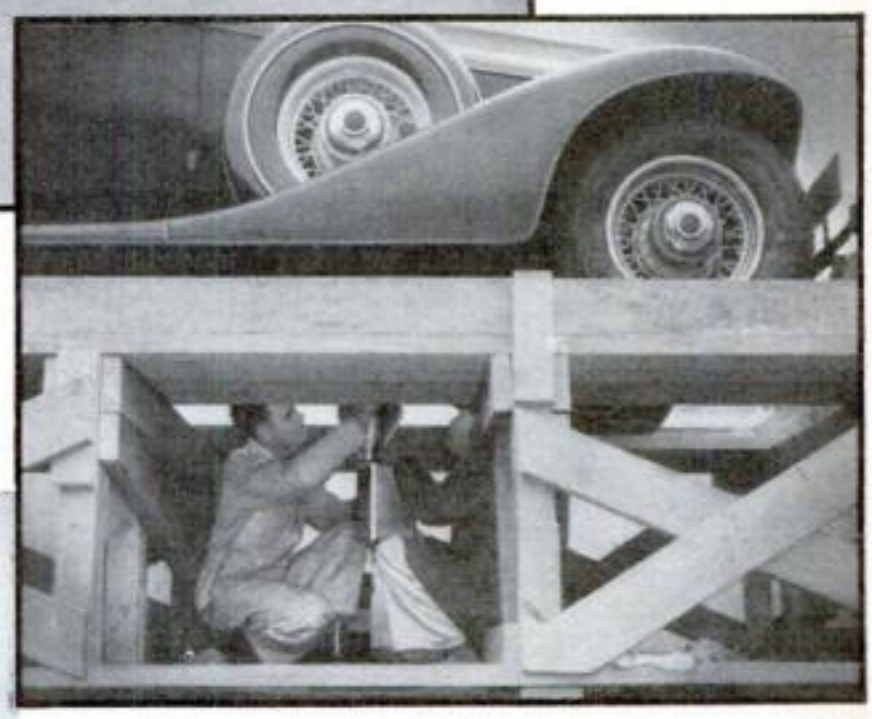
Designed to test the lubricating quality of a wax- and asphalt-free oil refined by a sensational new process, the recently completed tests were severe enough to begin with, but unlooked for complications made them almost fiendish. The car dashing back and forth between San Diego, Calif., and Seattle, Wash., had covered 53,280 miles of its stipulated run when the engine cut out. The car was afire. The drivers fought the flames unsuccessfully with fire extinguishers. The body was destroyed and the frame warped. Undaunted, the drivers removed the engine, bolted it into a new chassis, and roared on. After fording unbridged streams and pushing at almost top speed through fog and rain, the new car rolled to a stop at the Ascot speedway near Los Angeles an hour ahead of schedule.

The lot of five cars tested on the speedway was a constant and exhausting grind. Some of the cars carried the new oil in their crankcases. Others used oils of older type. But all the cars faced the same

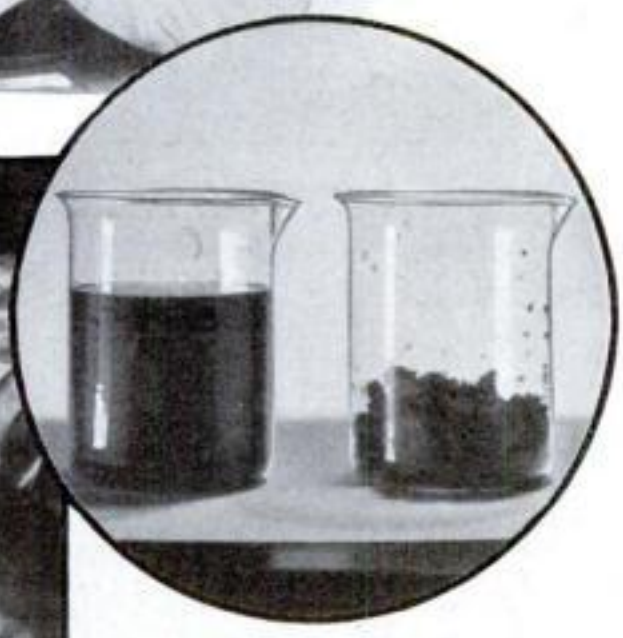
Test New Wax-free Oil



These passenger cars were driven night and day around the track to test the lubricant. Oil samples were taken three times in each 1,000 miles



Below, draining the crankcase of one of the motors used in the tests. This was done regularly at the end of every thousand miles. The oil was measured carefully to determine the amount that was used

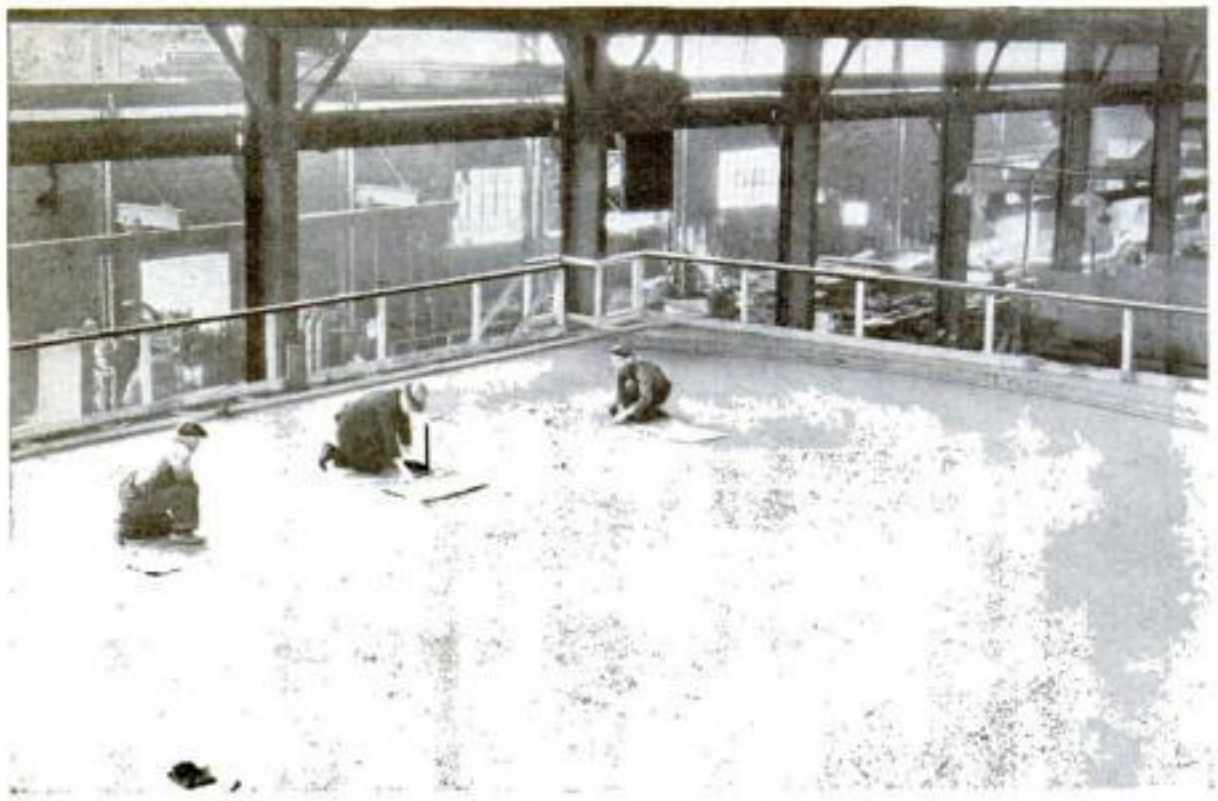


At top, Prof. R. L. Daugherty, of the California Institute of Technology, is measuring motor cylinder with a micrometer at the end of test runs. Left, view of filter showing wax that has been frozen out of propane solution of oil. Above, beaker at left contains oil from which wax has been filtered out. One at right holds the wax that was obtained by this filtering process

punishing routine. Driven by student engineers from the California Institute of Technology, the cars circled the track stopping only three times in each 1,000 miles to take oil samples and at the end of that distance for flushing and refilling the crankcase. Drivers grew sleepy and stiff but the cars sped on until they had covered 60,000 miles, the equivalent of twenty trips across the continent. At the end of the punishing runs, the engines of the cars were taken down and carefully measured in a laboratory to determine whether wear with the new oil was less than with that refined by older processes.

The method used in refining the new oil is based on discoveries made by Dr. Ulric B. Bray, a California petroleum chemist, in experiments with propane, a highly volatile ingredient in natural petroleum. When mixed with crude oil under pressure, propane dissolves nearly all the foreign matter except asphalt. The propane is introduced into a heavy cylinder under 180 pounds pressure. The oil stock is then poured in and the cylinder turned end over end. When the oil and propane have mixed, the asphalt separates and falls in semi-solid state to the bottom of the tank, whence it is drawn off. The asphalt-free oil is then conducted under pressure to another tank, which is fitted with valves so the pressure can be reduced. As the pressure falls in the second tank, the propane evaporates and the evaporation reduces the temperature of the oil to forty degrees below zero Fahrenheit. At this temperature, the wax in the oil is frozen and is easily filtered out.

OBSERVATORY PLANS DRAWN ON FLOOR

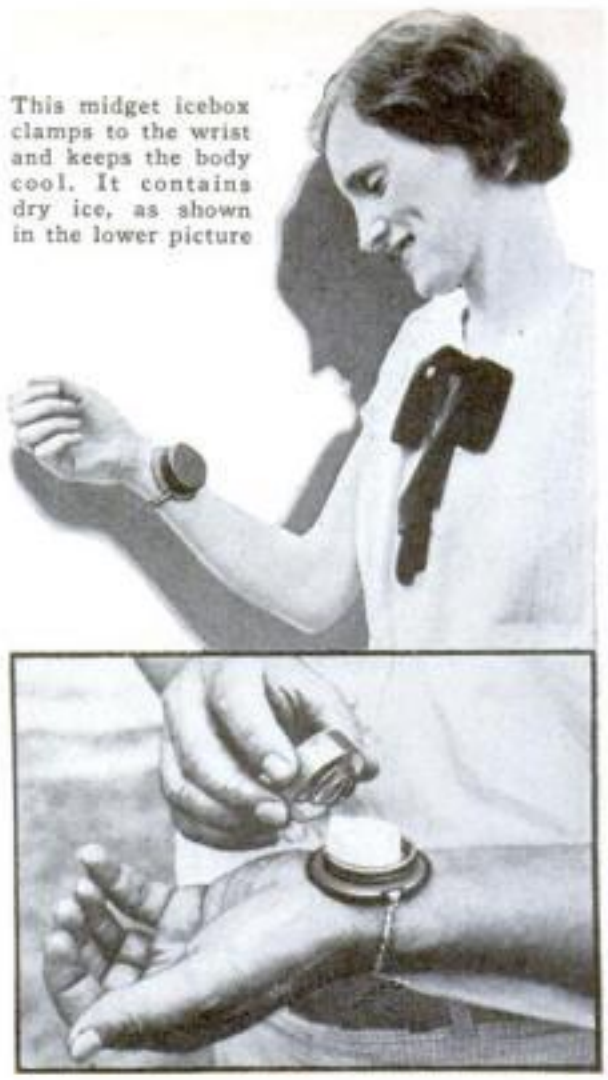


FULL-SIZED plans for the new observatory at the University of Texas are being drawn on what is probably the world's largest drafting board. The board is actually a section of a big floor in a Cleveland, Ohio, steel mill. Preliminary drawings are made in the usual way in the drafting room and then drawn to full scale on the floor. Wood patterns are then made to correspond exactly with the huge drawings.

PLATE GLASS MOVED WITH SUCTION CUPS

A RECENT German invention permits large sheets of glass to be handled without danger of breakage. The handle of the tool connects two metal disks which are fitted on the under side with rubber suction cups. When these cups are pressed against the glass, the tool will lift a sheet weighing up to 155 pounds. The cups are released by pressing the handle to one side.

Left, close-up of suction cups used, as above, to move a glass sheet



This midget icebox clamps to the wrist and keeps the body cool. It contains dry ice, as shown in the lower picture

ICEBOX ON WRIST TO COOL THE WHOLE BODY

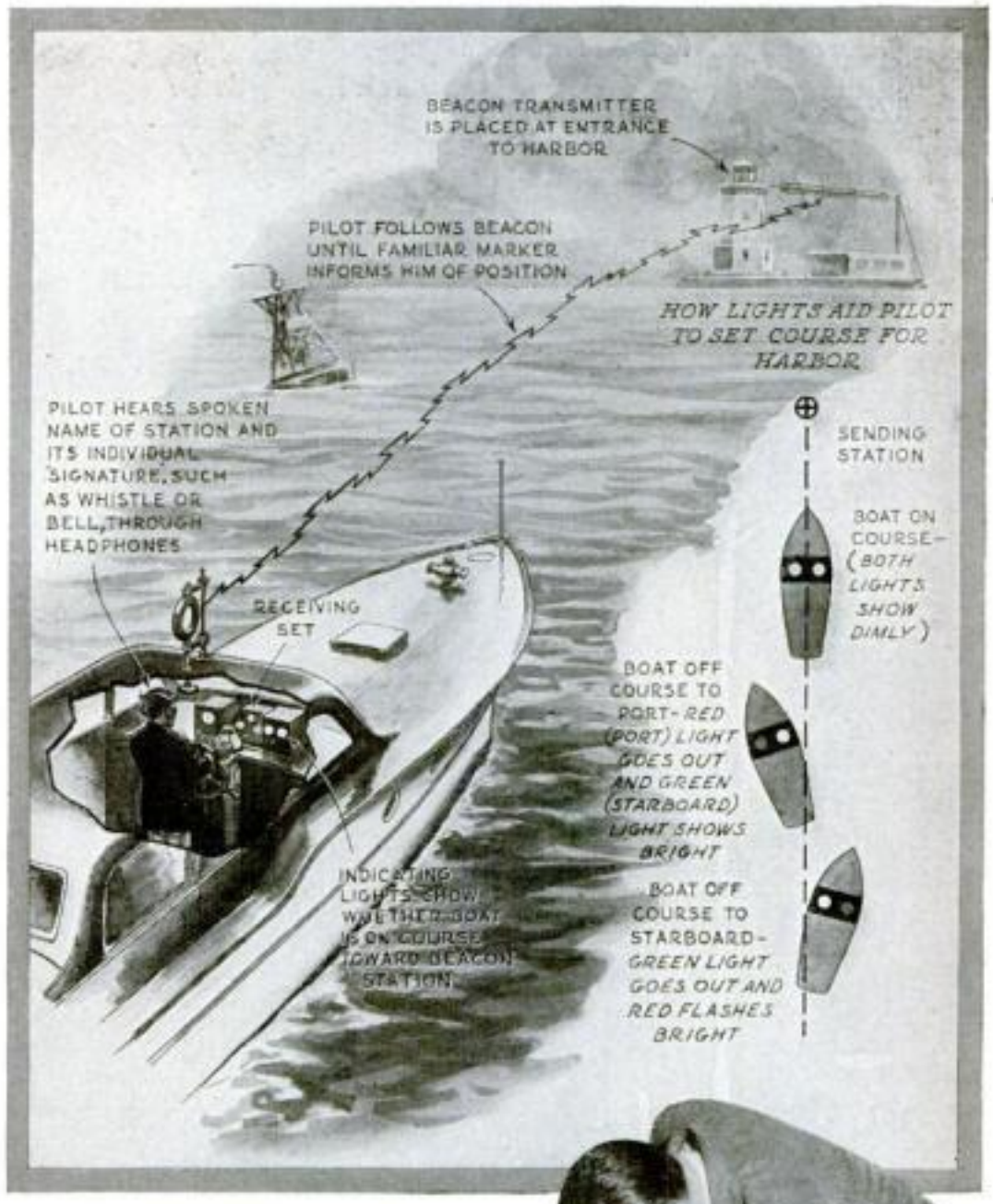
PURDUE University physicists say the whole body may be kept cool during the hottest weather by a recently developed miniature refrigerator that straps to the wrist in the manner of a watch. The refrigerator is somewhat larger than a wrist watch and encloses a pellet of dry ice—solid carbon dioxide. As the dry ice evaporates, it forms an invisible gas. Escaping from the case, the gas has the same effect as cold water poured over the wrists. It lowers the temperature of the blood in the arteries and this cooled blood is carried to every part of the body. The metal case is insulated from the wrist by rubber, as the temperature of the dry ice is 109 degrees below zero and its contact with the skin would result in a severe burn. With proper insulation, however, there is no danger of this occurring. And thus the device can be worn in perfect safety.

AMERICAN PLANE SETS RECORD BY TOWING FOUR GLIDERS

NEAR Elmira, N. Y., an airplane recently made history by towing an aerial train of four gliders on a successful practice flight. The gliders, at the end of long tow lines, skimmed across the field in the wake of the plane and were in the air before the plane left the ground. In flight, the motorless craft were towed in a diamond-shaped formation. This flight surpassed the feat of an air train flown in Russia several weeks ago, when an airplane towed three gliders 950 miles across country from Moscow to the Crimea. The Russian experiment sought to show that gliders could be used to serve remote regions of the country that lack both railways and landing facilities for airplanes. Even longer test flights of aerial trains are projected, both in this country and abroad. If successful the glider may be used as a trailer to carry freight and passengers.

Talking Beacon Guides Small Craft

AT TEN ports along the Atlantic Coast, pleasure fishing boats, blinded by fog or storm, are now being guided safely into harbor by the voice of a new talking beacon. This radio robot, recently invented by a New York engineer, is placed on the breakwater or light at the harbor entrance. During fog or storm, it flashes out automatic radio signals in a continuous stream—first a bell tone, or other distinctive sound adopted by the port; then the port's spoken name. Any craft equipped with a direction finder capable of receiving voice frequencies can pick up the signals as far away as fifty miles. A small, simplified direction finder soon to be placed on the market will be so inexpensive that most small boat owners will be able to install it. This has a fixed loop aerial, and signals would be heard most clearly when the boat was following a course straight for the robot. For visual indication of the boat's course, red and green lights would be installed in a prominent position in the boat. Both lights would be dimly illuminated when the course was being followed. Should the boat swerve to the right, the red port light would brighten and the starboard light go out. The green light would glow brilliantly if the boat strayed to the left. A photo-electric cell is used by the robot that transmits signals. An endless ten-foot sound film, carrying the signals, is drawn before the rays of a lamp by gears, turned by an electric motor. The cell feeds the signals to a radio transmitter. A similar robot, modified and more powerful, has been suggested as an aid to mariners in determining their distance from lightships transmitting radio guiding signals. For such use, the film would have two sound tracks. One would carry the spoken identification of the lightship and the other the warning "Bear off." Synchronized with the regular 300-mile code transmitter already used on the lightship, the robot would intersperse code transmissions with the spoken name of the station. It would then shift automatically to the other sound track and at the same time reduce its transmitting power. In this way the "Bear off" signal would not be heard beyond five miles. A ship entering the 300-mile zone would pick up the lightship's code identification and immediately after would hear the spoken name of the station. As the ship entered the five-mile zone, however, these two signals would be supplemented by the warning.



Artist's sketch above shows how the talking beacon guides boats to port. At right, transmitting equipment that sends the signals

Below, interior of the talking beacon's transmitter, showing sound film. Right, the receiving apparatus carried by boats

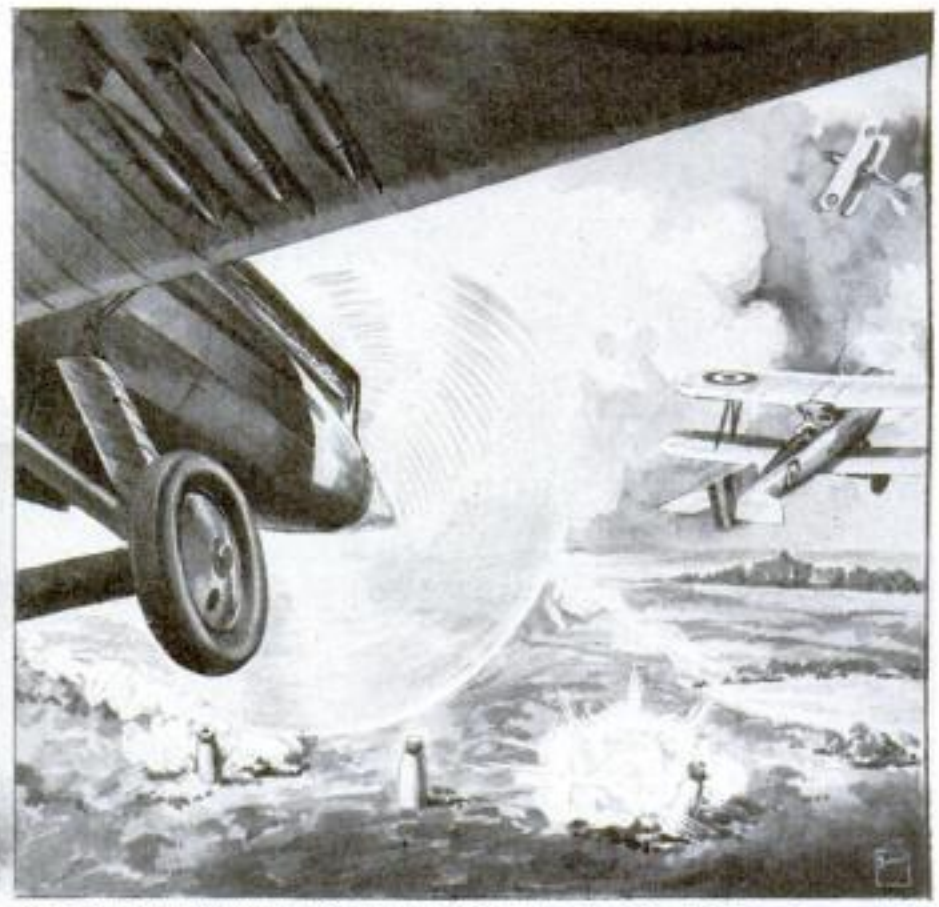
REFLECTOR MAKES HAND SIGNALS SHOW AT NIGHT

DESIGNED to make hand signals more clearly visible, an ingenious new reflecting lens that fits on the back of the hand affords extra protection for motorists while driving at night. The circular red lens is set in a glovelike arrangement for slipping over the hand. The headlight rays from a car following are reflected brilliantly by the lens, giving notice of any intention to turn or slowdown.

Reflector fits on back of hand like a glove

Airmen Bowl with Bombs for Missiles

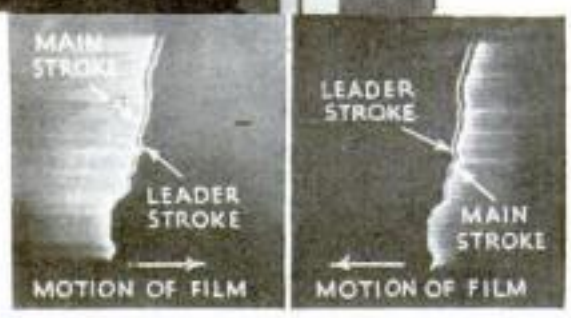
SKITTLES, a British variation of the game of ninepins, was played from the air for the first time the other day. The spectacular stunt was a part of a recent Royal Air Force display at Hendon, England. Constructed of fabric stretched on wooden frames, the giant pins were set up at intervals across an open field, and crack aviators vied with one another in attempting to knock the targets down. Their missiles were small practice bombs, which exploded with a burst of smoke and vapor. When one of the bombs was hurled with sufficient accuracy to land within a few feet of one of the big pins, the target was overturned by the explosion. Even though the rules of the game allowed the planes to skim as low as within 1,000 feet of the ground, considerable skill was required to let a bomb fly at just the right moment to find its mark. The game is expected to increase a pilot's skill.



Artist's sketch shows the giant game of skittles played by British airmen at the range of 1,000 feet. At left, soldiers are setting up one of the monster targets

CAMERA TELLS SECRETS OF LIGHTNING

Above, the high-speed movie camera used in analyzing flashes of lightning. Right, two of the series of ten discharges in a single stroke



USING a double-lens movie camera with film running at mile-a-minute speed, General Electric investigators recently discovered that a lightning stroke is not a single discharge but may include as many as ten distinct double flashes. Each stroke begins with a bolt shot earthward from the cloud. This faint discharge is followed immediately by a brilliant burst of energy from the earth to the cloud. The process may be repeated several times before the completion of what appears to the eye as a single flash. The shocks discharged by the clouds travel, the investigators found, at speeds up to 7,200 miles a second. The faster flashes reach a speed of 34,000 miles. This type of camera was first employed for lightning observations by two experimenters in South Africa and was previously described in this magazine. (P.S.M., June, '34, p. 21).

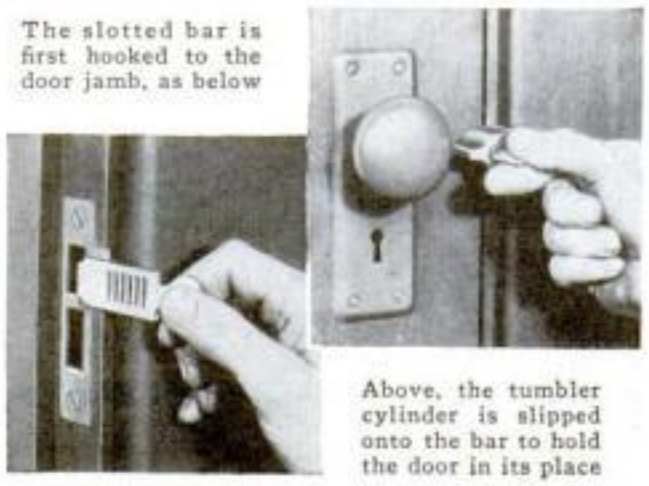
NOVEL FLAG FORMED OF COLOR-PRODUCING GERMS

COLONIES of bacteria provided the colors for a living American flag grown in Montclair, N. J., by a bacteriologist. The germs were made to perform their remarkable trick by tracing the outline of the flag on a shallow glass dish, with needles previously dipped in germ cultures. The dish bearing the bacteria outline was then placed in a incubator. There the bacteria of various colors multiplied and rapidly filled in the proper areas of the flag. The blue field was grown from a pigment-forming disease germ, while a bacillus found in mountain streams provided the red stripes. The white stripes and the stars were supplied by a non-pigment-forming bacteria found in milk. The flag, when the colonies of bacteria had attained the proper growth, measured about six inches long. Miss Roberta Love, Montclair bacteriologist, is shown above, holding the flag during an early stage of its development. Even in its unfinished state, the resemblance of the bacteria colonies to the regulation flag was readily apparent.

POCKET LOCK GUARDS HOTEL DOORS

A NEW lock that can be carried about in a pocket or handbag provides travelers with a convenient means of securing the doors of hotel rooms and hotel closets. It consists of a tumbler cylinder and a separate locking bar. The bar is hooked into the door-jamb mortise that takes the regular latch. The door is then closed and the tumbler cylinder is slipped on the bar until it touches the door. When the key is turned, the tumblers fall into the grooves in the bar and the door is thus securely locked.

The slotted bar is first hooked to the door jamb, as below



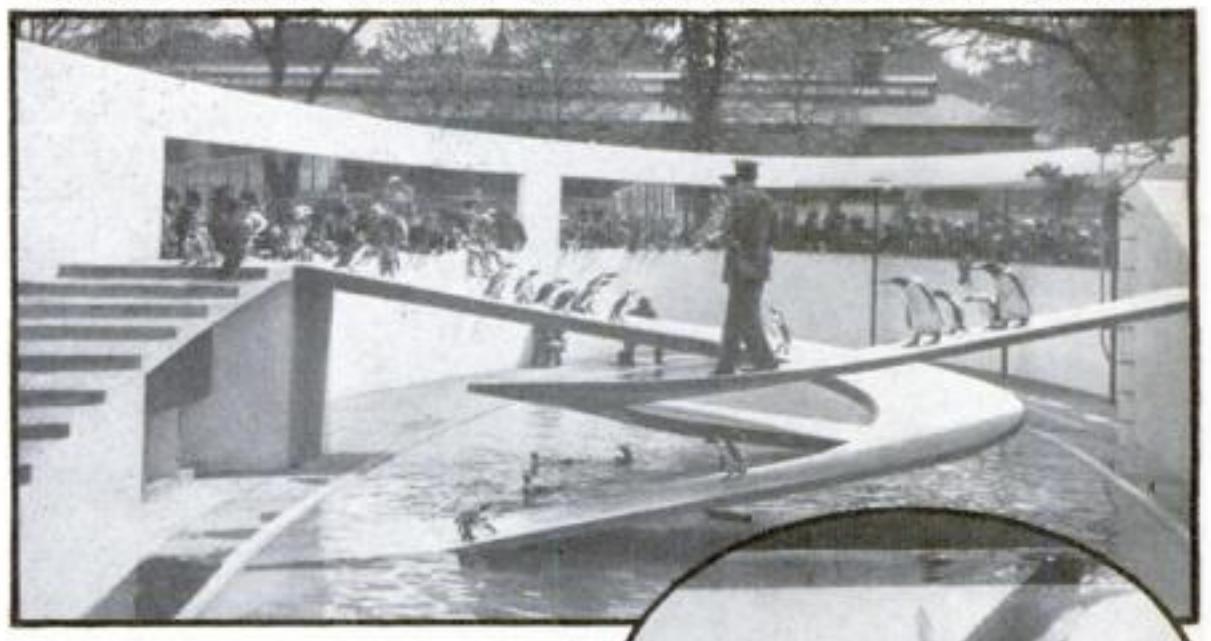
Above, the tumbler cylinder is slipped onto the bar to hold the door in its place

PEASANTS USE VAULTING POLES TO GET TO WORK

VAULTING with poles is a necessary part of the every-day life of Friesian peasants in northern Germany. There the low, marshy fields abound with drainage ditches. These are so numerous that the construction of foot bridges would be prohibitively expensive. Hence the peasants resort to vaulting poles, which have wooden disks attached to the bottom end, as shown in the smaller view, to keep them from sinking in the soft mud. Long practice has made the Friesians adept in leaping the ditches in this manner.

End of vaulting pole showing disk at tip

PENGUINS DIVE IN GLASS-SIDED TANK



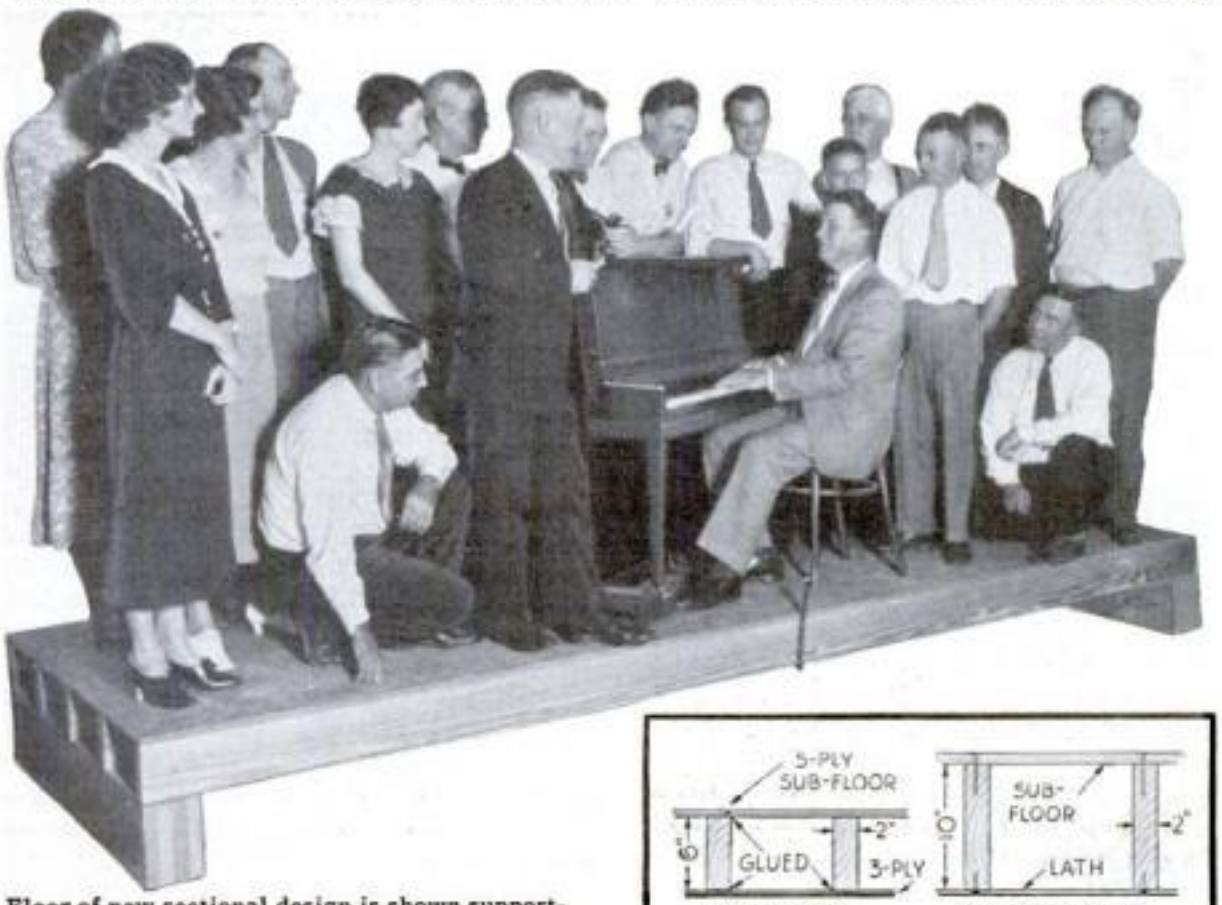
TO GIVE penguins a chance to exhibit their graceful diving, their new quarters at the London Zoo have been provided with two spiral ramps and a glass-sided diving tank. The gently sloping spirals lend a modernistic touch to the enclosure and enable the penguins to reach the diving tank by walking up from the level of the main tank. At feeding time the penguins dive into the tank to obtain fish.

At top, penguins on spiral ramp leading to diving tank. Above, under-water view of diving penguin

STATUES ARE AMSTERDAM STREET SIGNS

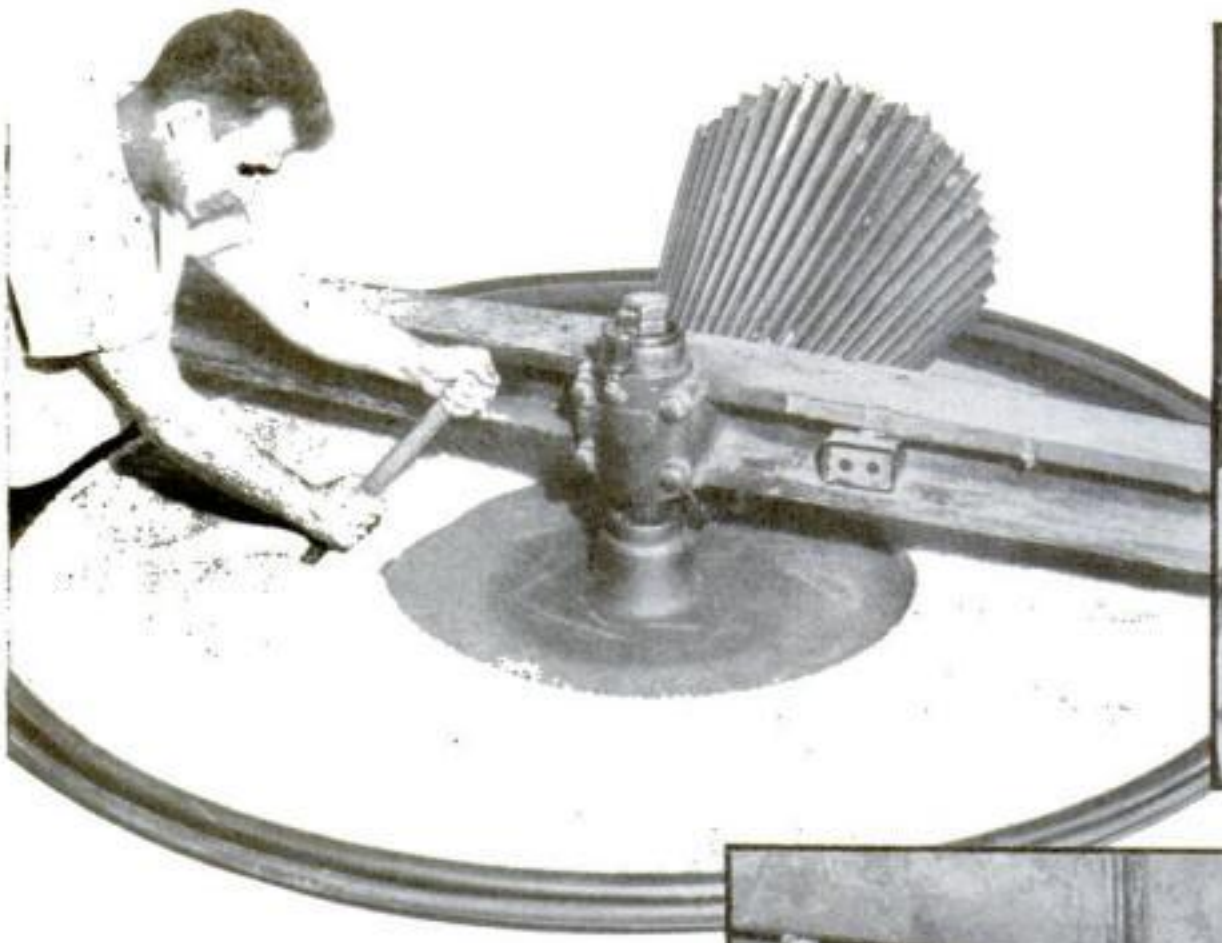
STONE likenesses of the famous persons for whom its streets are named are being included by Amsterdam, Holland, in what are probably the strangest street signs ever erected. Many of the city's streets are named for famous painters, musicians, and sculptors, including Rubens, Michelangelo, Beethoven, Raphael and others. Sculptures of these artists are set at corners to mark the streets.

AIRPLANE BUILDERS FURNISH IDEA FOR NEW SECTIONAL FLOOR

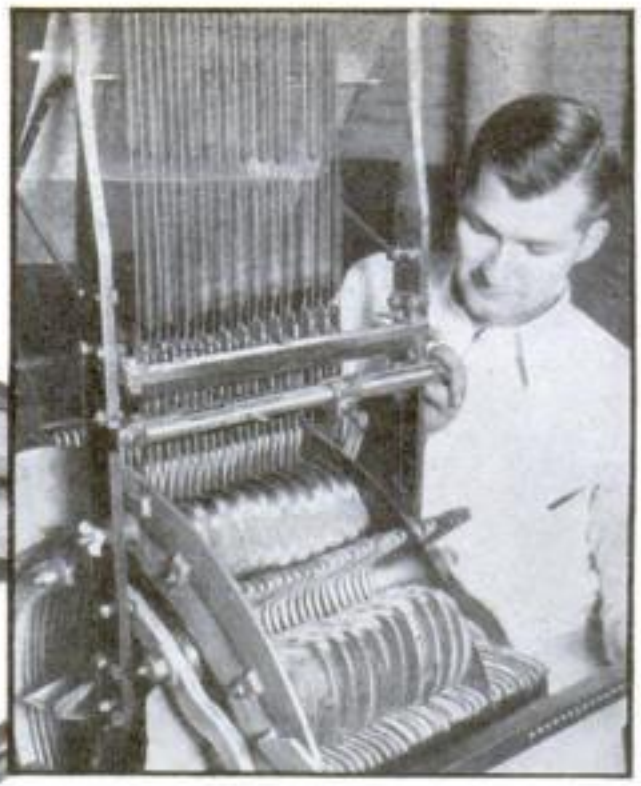


Floor of new sectional design is shown supporting eighteen persons and piano without appreciable sagging. Right, view of old and new floor

ADAPTING a principle developed in aircraft practice, a new type of sectional floor construction for dwellings is said to support greater loads than ordinary floors while employing lighter timbers. In the new floor, designed by the U. S. Forest Products Laboratory, the joists used are only two by six inches, compared with the two-by ten-inch joists usually required. Added strength in the new design is gained by joining several of the joists together in four-foot sections by means of plywood sheets cemented to both the top and bottom of the joists. The plywood is said to distribute the load more evenly than is done in floors of conventional construction. The top sheet of five plies serves as a sub-floor and the bottom sheet of three plies forms the ceiling of the room below. In a recent test, a section of the new flooring supported a load of nearly 3,000 pounds over a span of thirteen and one half feet with a sag or deflection at the middle of only a quarter inch. Most building codes permit nearly a half inch deflection. An advantage claimed for the new construction is the saving of four inches in the thickness of floors, with a corresponding gain in head room.

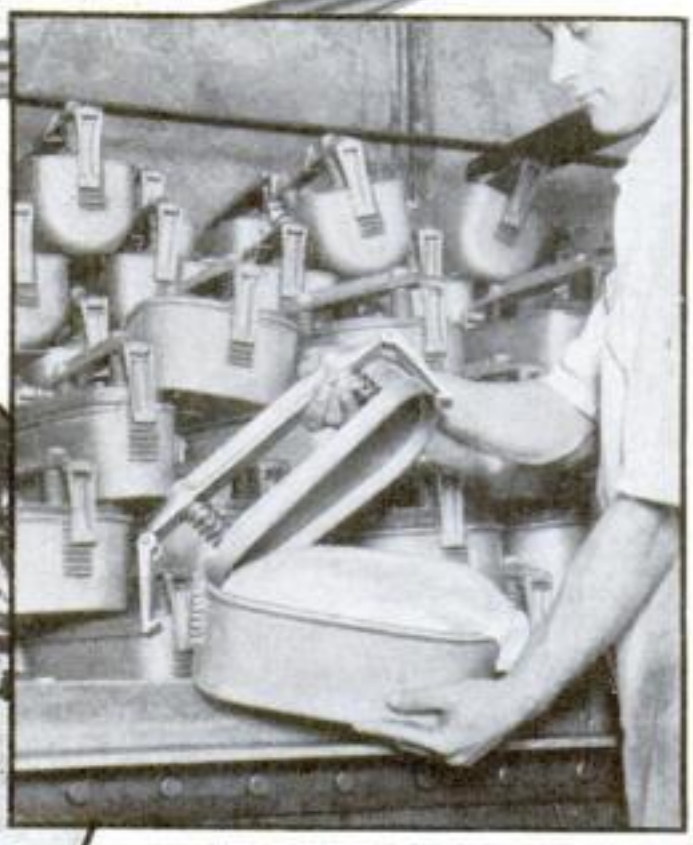


A GIANT ROLLING-PIN. This queer machine, with its revolving disk and corrugated roller, works dough to just the right consistency for spaghetti. Lumps of dough are thrown on the disk, which carries them around while the roller mashes them out evenly



ROBOT BREAD SLICER

Even the most skilful housewife could not slice bread as neatly as this automatic device can. Each loaf rests in a trough on a revolving drum as scores of hack-sawlike blades cut it into thin, even slices. As shown in the picture, the walls of the trough are ribbed so the blades can pass through



MEATS ARE MOLDED WHILE THEY COOK

Meats are cooked in individual metal containers like the one shown at the left. Sealed with springs and clamps, it cooks the meat in its own juice and at the same time molds it into the shape desired. In cooking, the containers are placed in huge stoves which hold as many as six hundred of them at once

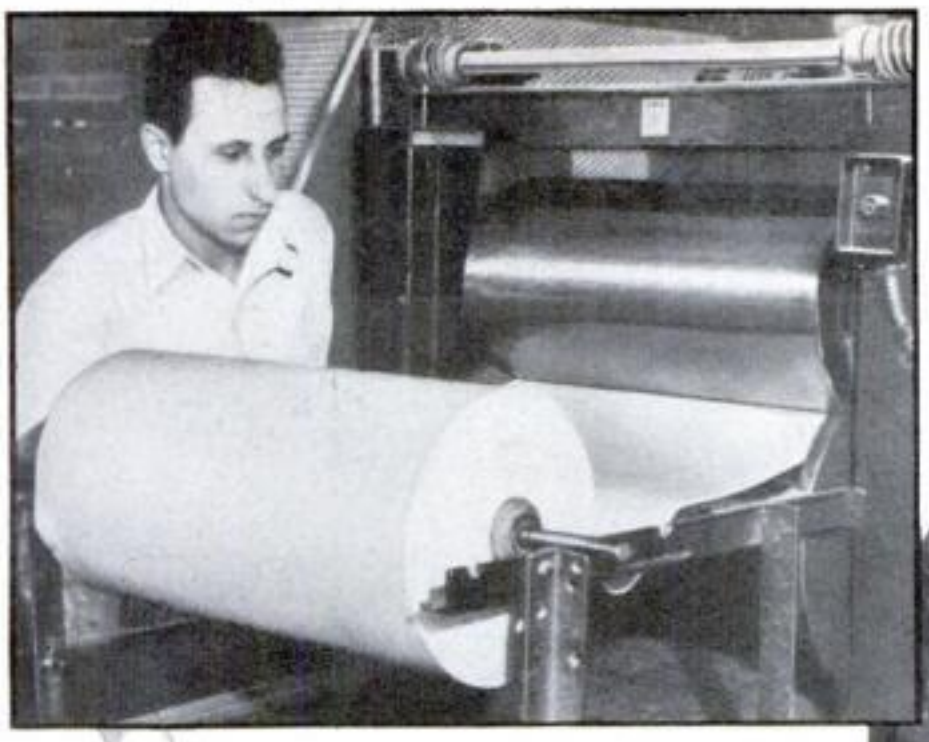
ADDING BOTTLED SUNSHINE. The man in this picture is adding the necessary vitamin D to a food product by mixing in a vitamin-containing preparation which has been exposed to ultra-violet rays. It is said that foodstuffs so treated retain their full vitamin strength indefinitely

FRUIT JUICE FROZEN SOLID

This man is holding a cylinder of fruit juice, frozen solid at a temperature of fifty degrees below zero. Orange, lemon, and grapefruit juice keeps fresh when it is shipped this way

New Marvels of

PERMITTED to peep behind the scenes in a giant food plant, a housewife would envy the speed and exactness of the modern machines used in preparing and packing food. The variety of these error-proof automatic devices is almost endless. In bakeries, massive, yet delicately adjusted mixers weigh and sift flour and measure water, mixing enough dough for hundreds of loaves of bread in one batch and assuring uniform taste and texture. The baked loaves are brought into position before a rank of dancing hack-saw-like blades that slice them in a flash, more nearly even than the most skilful housewife could do. Huge disks, rotating under corrugated rollers, knead spaghetti dough to a uniform consistency. Noodle dough is rolled into thin sheets by machines a thousand times the size of the kitchen rolling-pin, wound up on rollers like printing paper, and then deftly formed into various kinds of noodles. In fruit and vegetable canneries, refrigerators produce arctic temperatures to freeze fruit juices solid in the can and so preserve indefinitely the tree-ripened flavor. Green corn is frozen on



Noodle dough, coming out of the machine that kneads it, looks like paper rolled up on a printing press.

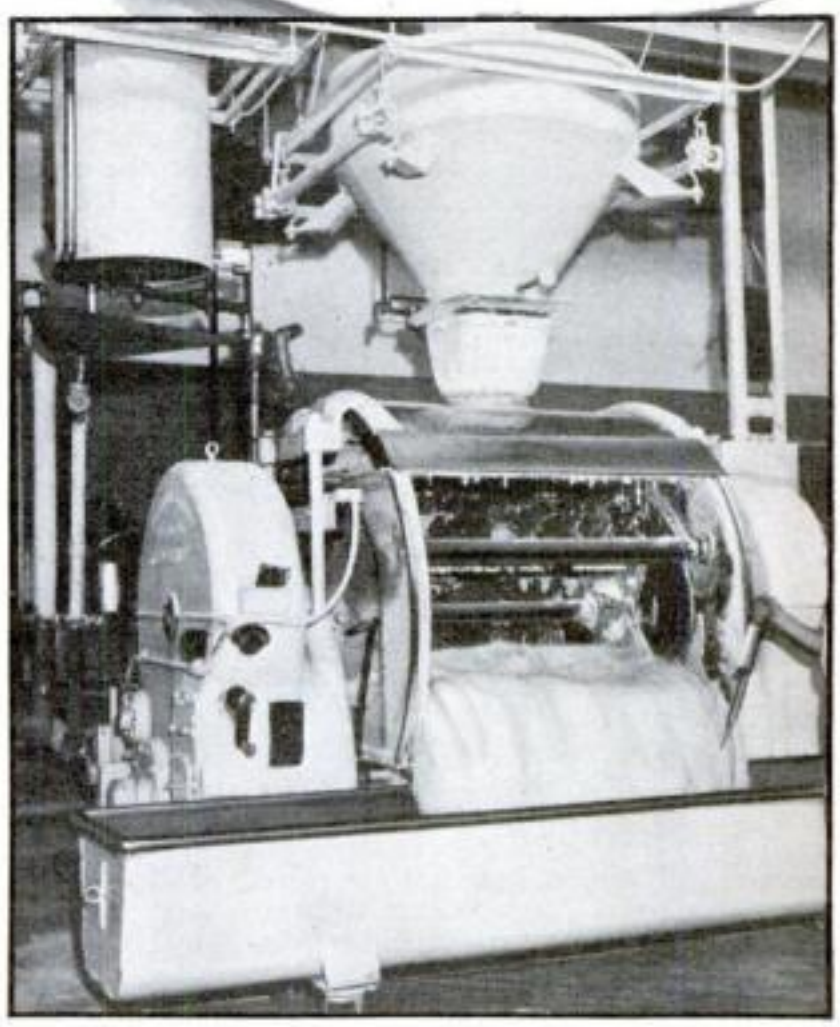
Pipes lined with charcoal, as seen at left, are used to carry the hot soup from floor to floor in a big cannery. As soon as one batch is cooked, it is run off to one of the canning rooms and sealed while it is still hot

MODERN WONDERS OF FOOD MANUFACTURE

Below, sausage meat is being shot into casings from nozzles on the mixing machine. Casings are gathered on the nozzles and paid out as the meat is fed into them at high speed. The strips are later tied to form the familiar links

Food Factories

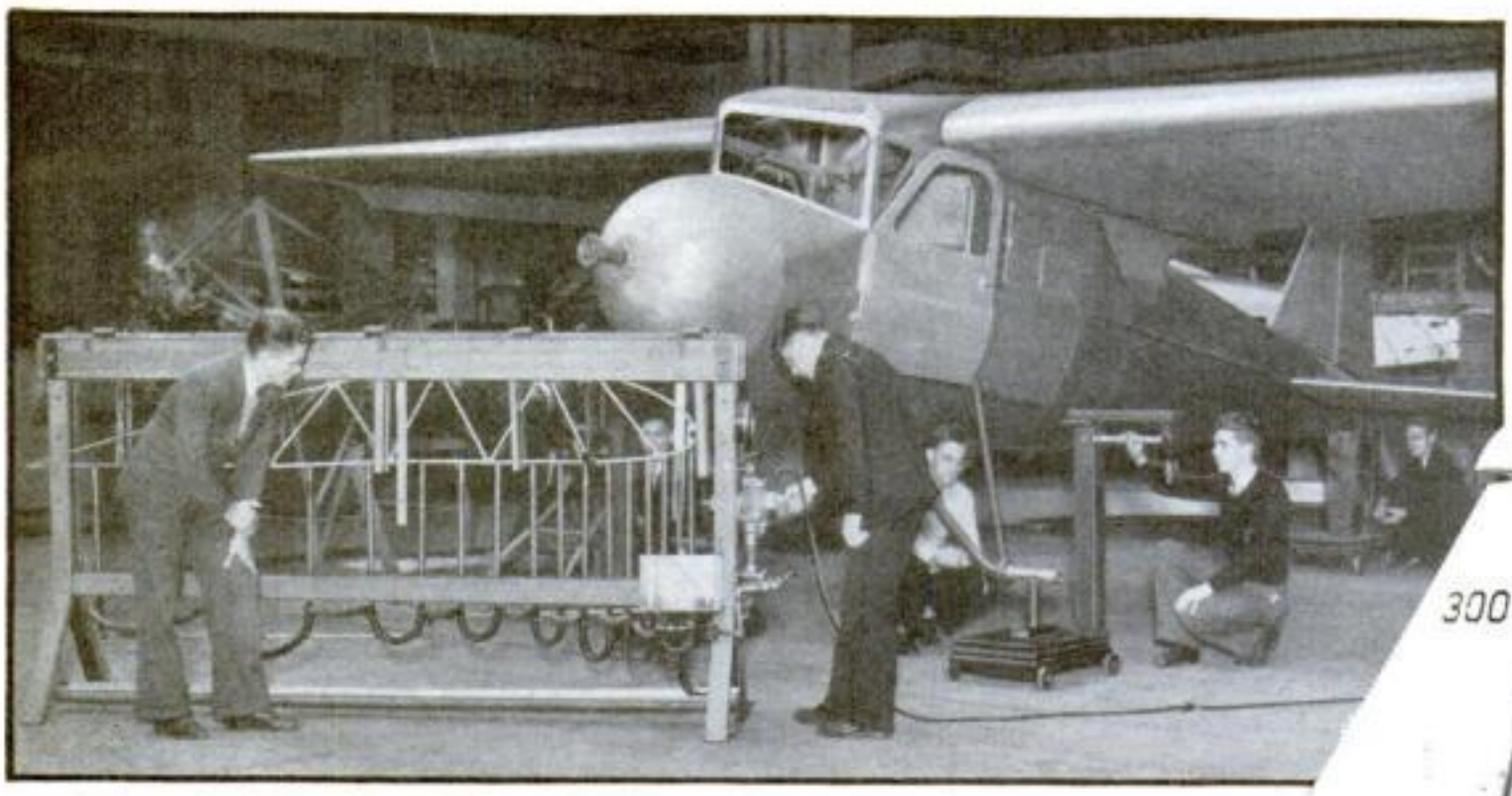
the cob on the day it is picked, for enjoyment at any season of the year. In meat-packing plants, high-speed mixers shoot yards of sausage and frankfurters into casings every minute, turning it out in continuous strings which are later tied at intervals to make the familiar links. Gigantic steam tanks cook 600 hams at a time, each ham encased in an individual metal container that seals the flavor in and also shapes the ham. The ham cooks in its own juice for a prescribed time at a definite temperature, automatic controls removing all guesswork. Many other kinds of meat are cooked in the same way. Charcoal-lined tubes in soup canneries quickly convey the hot soup from floor to floor and automatic canners fill the cans and seal them while the soup is still steaming. Vitamins are added to foods that lack them, in such a way that the vitamins are preserved. Little waste is permitted in factory cooking. The cooking liquids, usually wasted in the home, are carefully drawn off and the fats extracted to make soap. These marvelous machines represent the application of modern industrial engineering to the age-old art of cooking.



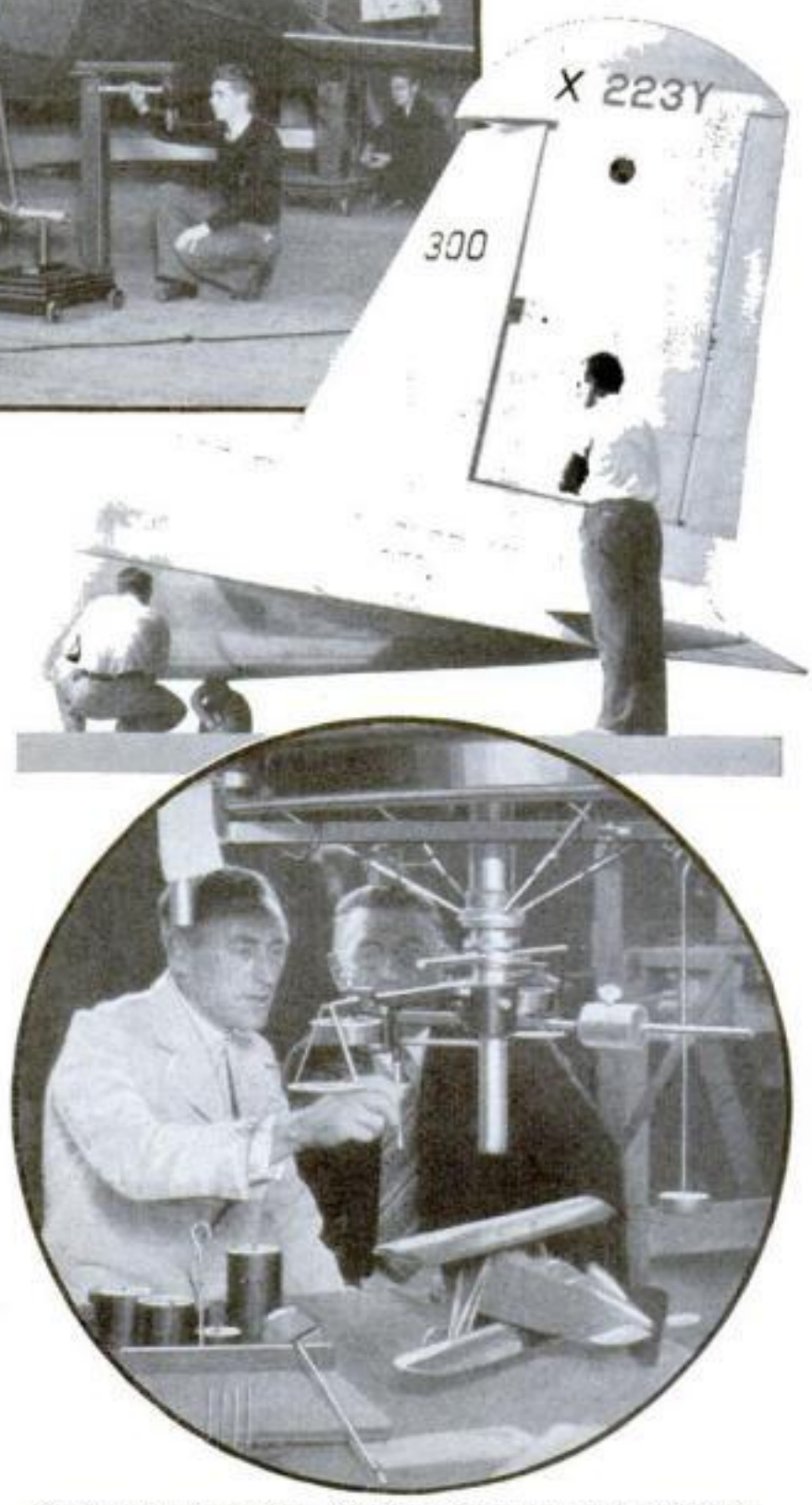
BREAD MIXED BY A MACHINE

The machine age replaces Grandmother's wooden mixing bowl with this error-proof automatic machine which mixes the dough for hundreds of loaves of bread at one time. It sifts the flour and weighs it, measures the water and the other ingredients, and mixes them in a huge cylinder like a washing machine. All guesswork is eliminated, because the "receipt" is followed by a mechanical brain that never errs. The result is bread that never varies in taste or texture

Safer Landings



Ordinary platform scales are used to determine an airplane's center of gravity, and wing ribs are tested with the apparatus in the foreground



The gigantic rudder shown below makes a new transport easier to fly. The narrow rudder was proved by laboratory tests to help the main rudder

Spectacular safety tests with full-size planes are invariably preceded by experiments on models with laboratory instruments

AN AIRPLANE comes roaring out of the sky over Langley Field, Va. Three hundred feet above the ground the power is cut off, and the plane glides swiftly and silently down toward the landing field.

Stop watches ready for action, a group of intent flight scientists of the Langley Memorial Aeronautical Laboratory watch it eagerly. As it coasts down its air path at mile-a-minute speed there is just time to notice two unusual features about the craft. One of them is that the struts of its landing gear are somewhat longer than is usual. The other is that there is a paper bag at the end of a fifty-foot length of cord trailing from its fuselage.

The paper bag strikes the grassy field and breaks in a little cloud of white dust. The stop watches click. Two and a half seconds later the landing wheels thud against the ground, and there is another puff of white dust as a second paper bag, suspended between the wheels, breaks on the grass.

The plane rolls off across the field, then comes to a stop. The distance between the two white marks on the ground is measured. Two hundred feet. Then the distance from the second mark to the plane. Three hundred and twenty-seven feet.

We have seen the first limited-control-glide landing in aviation history. The plane has come from a fifty-foot altitude to a stop on the field in a little more than 500 feet. Earlier tests have shown that the shortest landing from a fifty-foot height to a stop, made in the usual way, of which this particular plane was capable was 1,300 feet. Even more important, the limiting of the upward movement of the elevator used in this pioneer landing has done away with the hazard of the plane's stalling and going into a spin while dangerously close to the ground.

By this test flight the scientists of the National Advisory Committee for Aeronautics have shown the way toward the increased safety in landing that is one of the most pressing problems in the job of making air travel safe.

Statistics prove the seriousness of the landing hazard in aviation. Comparatively few accidents occur in air transport line scheduled flying; for the last two and a half years the average is one accident per 429,692 airplane miles. But between January, 1931, and July, 1933, there were a total of 5,210 airplane accidents in the United States—an accident for every 63,234 miles flown in all classes of air service. More than half of these accidents occurred in making normal or forced landings. Another fifteen per cent of them were crashes following stalls resulting in spins with the planes at low altitudes.

This means that more than two thirds of all our airplane accidents in that period —3,783 crashes of greater or less seriousness—had to do with the making of landings at airports or emergency fields.

Much had been learned about the behavior of airplanes in spins, but there was little definite knowledge of what a plane does when it is placed in a situation likely to result in a crash, so a study of the subject was undertaken at Langley Field. Flight scientists, armed with delicate instruments, went into the air in ten planes ranging in size from a 1,320-pound two-passenger monoplane to a 13,500-pound twenty-one-passenger airliner.

Many serious accidents have occurred when airplane engines have stopped shortly after the take-off, especially in cases where

for Swift Planes

BY ARTHUR GRAHAME

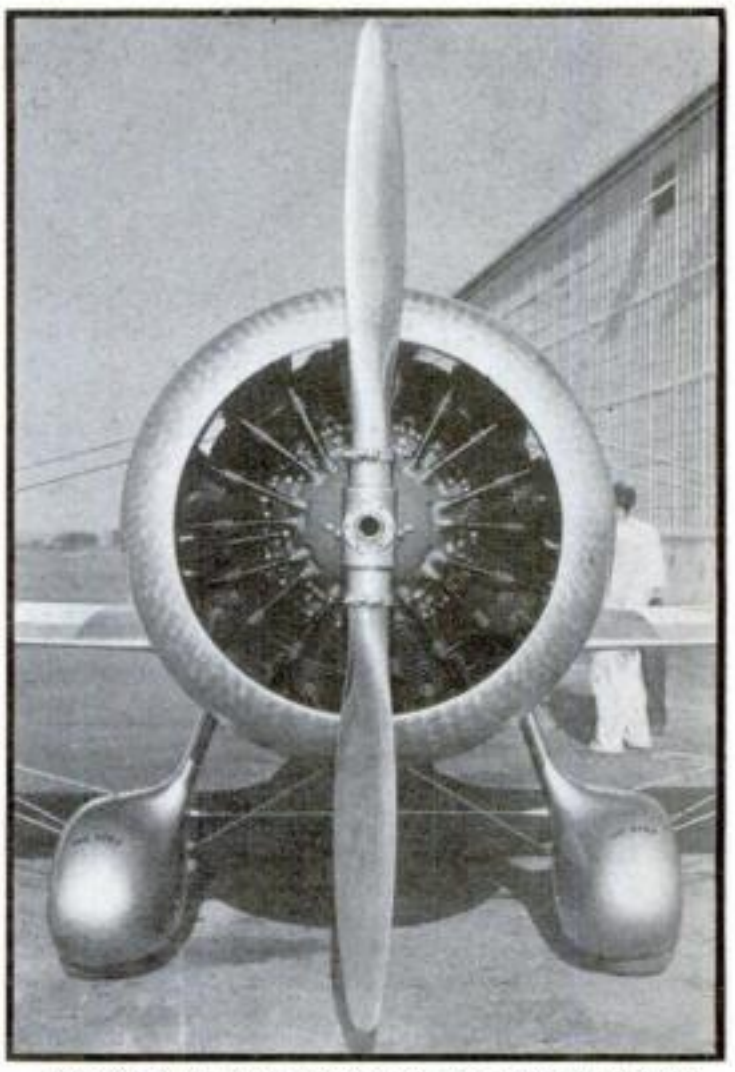
the pilot has attempted to turn back toward the field. In one of the series of flight tests at Langley Field this situation was simulated. Each of the ten planes was put into a steep, full-power climb; then the throttle was closed suddenly, and the plane put in a glide as quickly as possible. In each case it was found that a landing could have been made without serious danger.

All of the planes could be successfully put into a turn immediately after the power was shut off, but the instruments showed that a 180-degree turn resulted in a loss of altitude of from 250 to 300 feet. In consideration of this inevitable loss in a turn without power, the N. A. C. A. advises pilots whose engines have failed shortly after a take-off never to attempt to turn back toward the field unless they have reached a height of at least 400 feet.

In another series of tests the throttle was closed and each plane put in a glide. Then the control stick was pulled back as far as it would go, moving the elevator upward and so lifting the nose of the plane, and held there. It was found that with the stick in this position nine of the ten planes could be held safe in a straight glide. But it was different when even a slight turn was attempted. Then six of the ten planes went into spins. The controls of the four planes that did not spin, it was found, did not permit enough upward movement of the elevator actually to stall the plane and so kill its flying speed.

From this a really valuable lesson was learned—that the degree of danger of an airplane accidentally falling into a spin from a stall depends entirely on the amount of upward movement of the elevator that is possible. If the elevator movement is limited sufficiently, no airworthy plane can be made to spin without the use of power.

Having scotched the accidental spin, the most dangerous of landing hazards, the N. A. C. A. scientists went on experimenting. Flight tests showed that the gliding speeds of the experimental planes with limited elevator control ranged between fifty and sixty-two miles per hour, and that at these speeds the planes dropped between twelve and twenty-four feet per second. The plane which had the twenty-four-foot vertical velocity was fitted with specially designed struts to absorb the shock of the steep landing. The experiment of gliding straight to the ground was then made, and, as has been told, the new limited-control-glide landing proved successful.



Cowling and wheel "pants" of this racer of Roscoe Turner's are really products of laboratory research

John F. Victory, secretary of The National Advisory Committee for Aeronautics. Note the diminutive wind tunnel

Future aeronautical engineers studying problems of design and construction with the aid of models at a technical school in California. The latest devices are demonstrated in this way

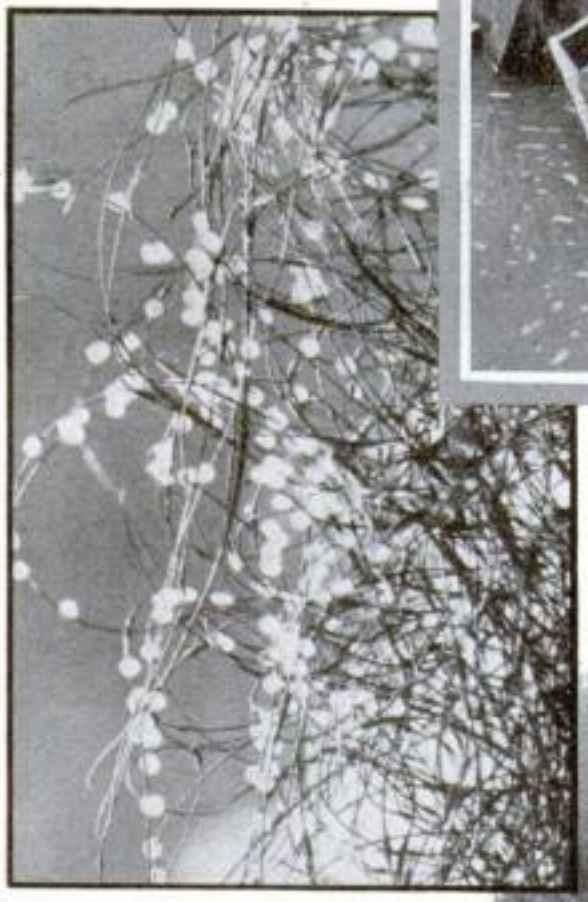
With the startling recent increases in airplane speeds, there has grown an urgent need for some sort of effective air brake. Several devices intended to accomplish these purposes have been tested at Langley Memorial Laboratory.

Wind-tunnel tests showed that the Fowler variable area wing has the greatest lift of them all. It consists of a main wing, and of an extension surface of the same sectional form as the wing. In high-speed flying the extension surface is entirely retracted in the lower rear portion of the main wing. When the pilot wants to reduce his plane's speed, he extends the flap. This increases the wing's lift by increasing its area, and also by increasing its camber, or curve. A gap between the main wing and the extension forms a slot that helps to maintain a smooth flow of air over the surface of the wing. The wind-tunnel tests showed that the main wing and its extension flap have a lift twice as great as has the main wing alone. They indicated that if the Fowler wing were used on an average monoplane it would cut down the landing speed by more than one third and thus add to its safety.

Another form of lift-increasing device is a retractable slat on the leading edge of the wing, which when extended forms a slot. A new-type slot used with the Fowler wing in wind-tunnel tests resulted in a still greater increase in the wing's lift. When this combination was used in flight tests it cut down the landing speed of a 2,000-pound plane from sixty to thirty-five miles an hour. It also made possible a steeper landing glide, and a *(Continued on page 117)*

RAISING *Goldfish* BY THE MILLION

Goldfish are spawned in boxes like the one shown at right. It contains nests of Spanish moss held in place by wire webbing. The female fish lay their eggs in these nests, where they can then be fertilized by the males



Above, goldfish eggs clinging to threads of moss in a nest. Right, an ingenious device for estimating the number of tiny fish in a pond. The reflector makes it possible to see them

Photos by the author

IF YOU own a goldfish, the chances are two to one it came from Martinsville. This southern Indiana town is the goldfish center of the world. Seventy-five million fish have begun life in the 600 ponds of its famous Grassyfork Fisheries.

When I spent a week, not long ago, watching the work of caring for these miles of goldfish, 10,000,000 baby fish had just rolled from their round white eggs and were darting about ponds and hatchery tanks. For the older fish, men were cooking mush breakfasts in giant 7,000-pound boilers. Other employees were busy shooting weed-killing chemicals into ponds; stalking watersnakes, muskrats, fish hawks; sorting, counting, packing goldfish and sending them racing across country in a giant truck that resembles a submarine and can carry 200,000 fish in a single load.

At Grassyfork, I discovered, goldfish raising is a highly specialized, mass-production, million-dollar-a-year business in which scientific research has played a key role. Incidentally, the work provides an absorbing show that attracts thousands of visitors a year.

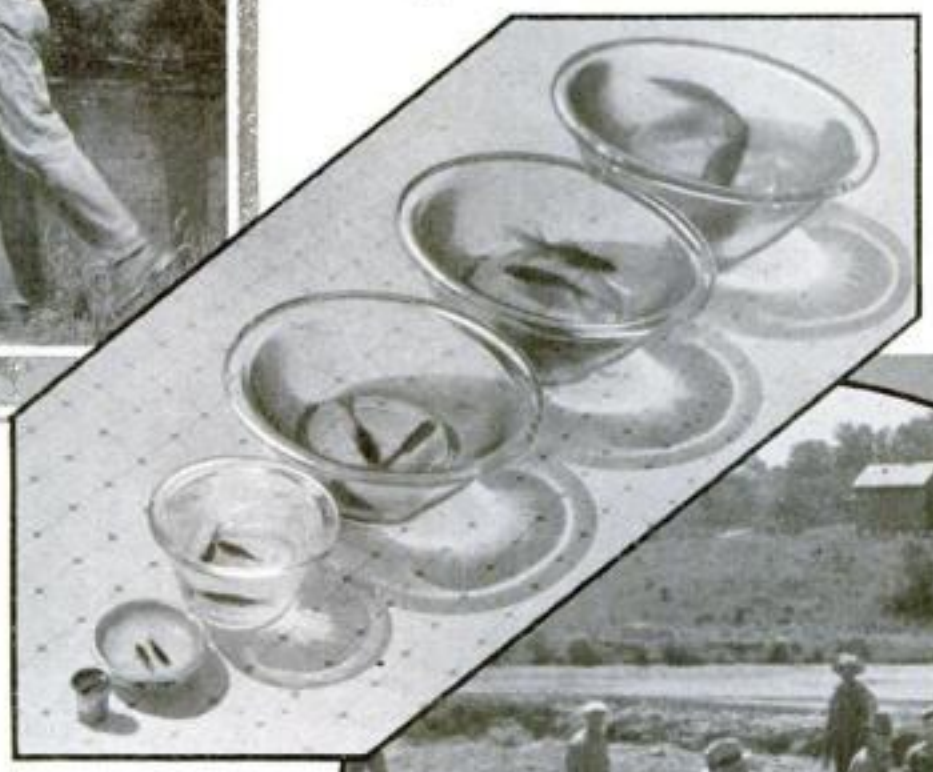
To go back to the beginning. About the year 1900, Eugene C. Shireman fell heir to a swampy farm a mile or so north of Martinsville. This was just twenty-two years after Rear Admiral Daniel Ammen, of the U. S. Navy, had brought the first goldfish to America from the Orient. One day, a friend from Indianapolis drove down to see Shireman. He was selling washing powder for a chemical company which had hit upon the bright idea of offering a small bowl and a pair of goldfish as a premium with its product. The scheme clicked from the beginning. In fact, it worked so well they had run out of goldfish. Shireman decided to turn his swamp into a fish farm and sell his crop to the chemical company.

He began with 200 goldfish, the original breeders whose descendants are now nearing the hundred-million mark. By the time he was turning out enough fish to sell, the chemical company had gone out of business. But other concerns were giving goldfish as premiums and during the next half-dozen years, Shireman's fish increased the sale of a score of products.

By EDWIN TEALE

A cheap grade of wheat flour is the food of the young fish. It is thrown into the ponds by the bucketful, as in the picture above

A new-born goldfish, in the test tube, is compared with a full-grown specimen. When first hatched, these tiny wiggletails are fed powdered egg yolk



The picture above shows the growth of the goldfish, from one day old when it swims in a thimble, to four months old

Above, collecting fish from a pond which has been drained for the purpose. Left, the fish are carried in pails to trucks for shipment

In fact, practically the whole demand for goldfish in the early days was for use as premiums to aid selling campaigns.

The average output, during the thirty-four years since the farm was started, has been more than 2,000,000 goldfish a year with the annual harvest soaring in the past few years to 7,000,000. At present, the ponds hold a surplus that brings the total number on hand close to 50,000,000. Full-grown and nose to tail, they would form a solid line of goldfish stretching 3000 miles from coast to coast!

Nearly 100 people keep on the jump caring for these millions of fish and running associated factories. The board bill for the goldfish, alone, reaches $75,000 a year, more than the feeding costs of any other livestock producer in the state. Wheelbarrows and horse-drawn trucks run along the levees between ponds to transport the various foods. They include tons of egg yolk, carloads of flour and enough mush and hominy to feed an entire army of men.

For a bird's-eye view of the vast-scale activity at this biggest hatchery on earth, let's follow the goldfish of one hatching through their life at Grassyfork.

Lining the edges of the eighty breeding ponds, you see rectangular frames of wood anchored in place. They contain curious nests of Spanish moss held in place by wire webbing. When the eggs are ejected by the female and fertilized by fluid shot into the water by the male, they adhere to the threads of moss like round, miniature pearls. Each is nearly transparent and about a sixteenth of an inch in diameter.

Some of the veteran breeders are more than a dozen years old, according to Capt. Harry Wood, manager of the plant. One female may lay as many as 75,000 eggs in a season. Spawning, which begins at sunrise, continues until about noon. When the eggs are firmly attached, the moss is transferred to one of the 216 concrete hatchery tanks. Unfertilized eggs rapidly become covered with fungus and soon have the appearance of tiny balls of cotton batting. The fertilized eggs, about

At concentration ponds near the shipping center, the goldfish are dumped into wire-screen cages, as shown above. They are then sorted as to kinds

At right, the unique tank truck used in transporting the goldfish is shown while being overhauled at the end of one of its frequent trips

sixty percent, hatch out into microscopic fry about the same color and hardly larger than mosquito larvae.

The first meal of these black wiggle-tails is powdered egg yolk. More than twenty tons of it, some coming from as far away as China, are used to satisfy the appetites of the baby fish each year. The equivalent of from fifteen to twenty dozen eggs may go into a single pond every twenty-four hours.

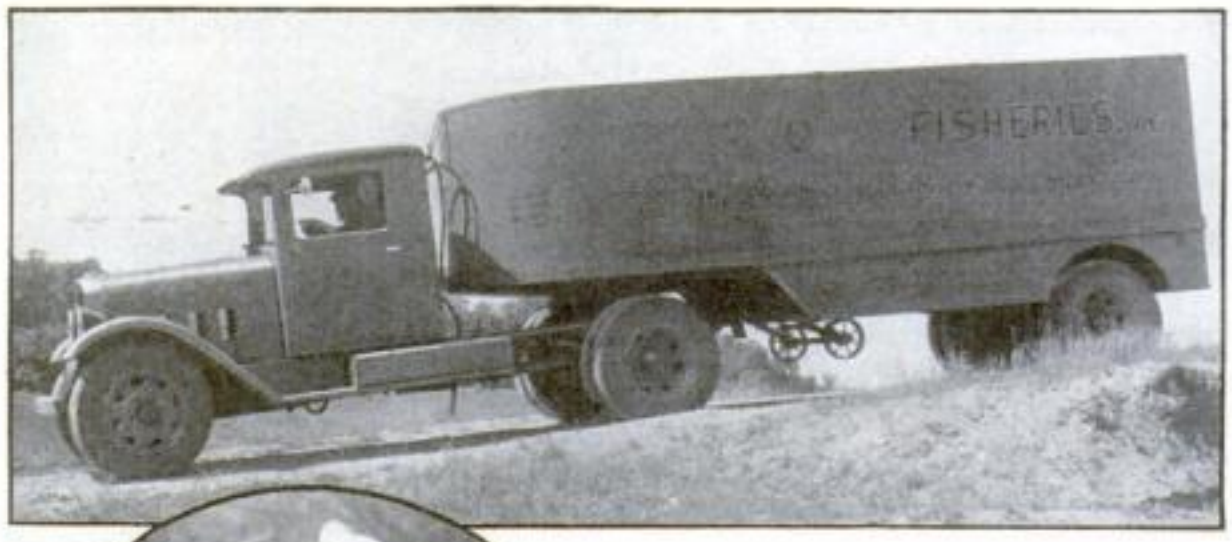
During the first ten days, the minute fish, which have the same appearance as the fry of carp or bass, dart about their concrete tank, gobbling down microscopic bits of food. At the end of that time, they are transferred to one of the 350 ponds reserved for little fish and soon afterwards are shifted to stronger fare. This is a cheap grade of wheat flour. It is thrown by the bucketful over the surface of the water. In twenty-four hours, 40,000 of the little fish will consume as much as thirty pounds of flour.

The ponds range in size from fifty feet across for the smallest to an area of eighteen acres for the largest. Fed by natural springs, they drain downhill from one to the other, emptying into Grassyfork Creek and Clear Creek which eventually reaches the Wabash River. The total area under water is more than 350 acres, consisting of 615 ponds.

Two ponds, with a combined area of almost an acre, contain no fish. They are given over to one of the queerest aquatic ranches in the world, producing billions and billions of water fleas, or daphniae, to feed the minnows.

On cool summer mornings, these ponds seem a solid mass of microscopic animal life as the water fleas, red, green, or brown, according to the color of the bottom, rise to the surface. At intervals, men collect them in cheesecloth nets and transfer them to the feeding ponds. Care must be taken in the amount of daphniae placed in a pool as too much may smother the tiny fish.

Ralph Van Hoy, one of the experts in charge of the delicate work of feeding, showed me an ingeniously simple device which helps him estimate the number of



As many as 200,000 goldfish can ride in this fish omnibus. It has temperature control and provision for mixing fresh air with the water

PUBLIC ENEMY NUMBER ONE

Peggy, Capt. Harry Wood's fox terrier, tackles a large water snake. The dog has killed many of these reptiles, which are among the worst of the hazards of raising goldfish on a large scale

fish in a pond. Because they are the same color as the water, the young fish are almost invisible, especially on cloudy days. Van Hoy's device is a stick with a bright square of tin at the end. When he runs it through the water, he can see the fish swimming between him and the tin and judge the number in the pond and how much food they will require. Most of the flour is thrown near the edges where mud can be scraped up at frequent intervals to see if any of the food remains uneaten. Overfeeding is one of the quickest roads to trouble.

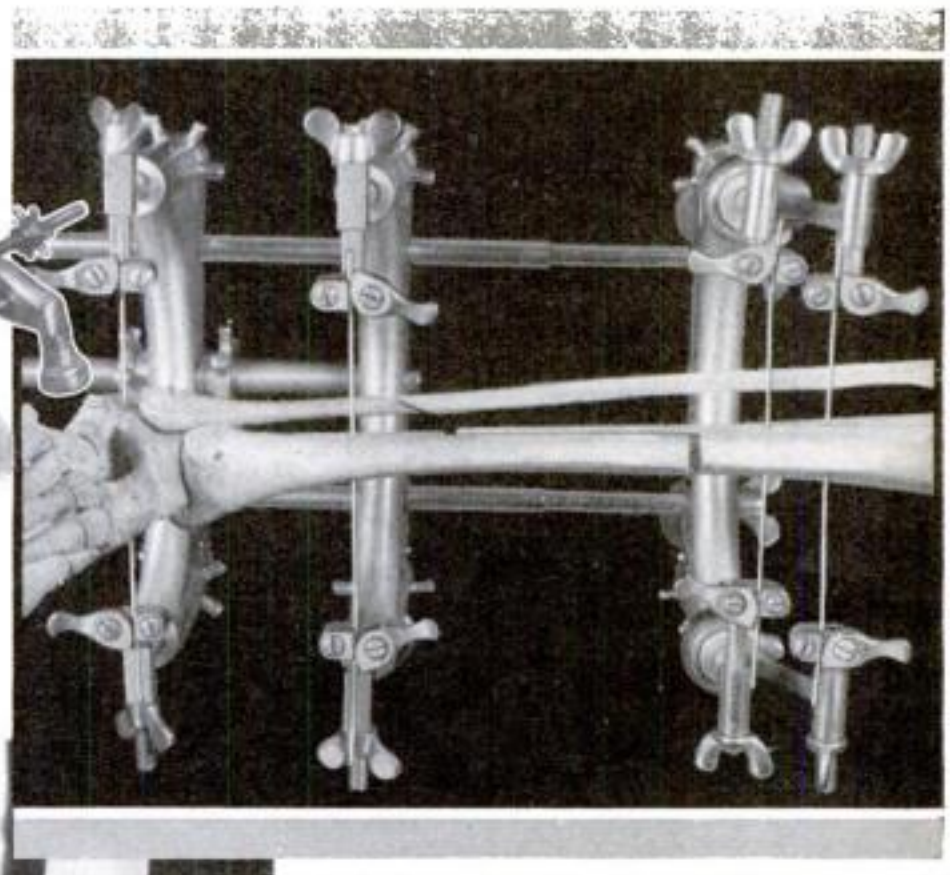
Thousands of dollars have been spent at Grassyfork in chemical research seeking a compound that will kill weeds without injuring fish. The successful formula is being kept a trade secret. One bizarre occurrence marked early experiments in this field. A weed-killer under test was sprayed over a pond. Afterwards the fish turned blood red!

Getting the right color and obtaining it as soon as possible are two problems of the goldfish raiser. For goldfish aren't goldfish until *(Continued on page 108)*

Surgeons Stretch Crippled Legs

Amazing new operation severs bones and then lengthens them gradually until a short limb attains normal proportions so limp vanishes

During the bone-stretching process, the patient's leg lies in this machine. The foot is against the plate at extreme right and back of knee in the receptacle at the left



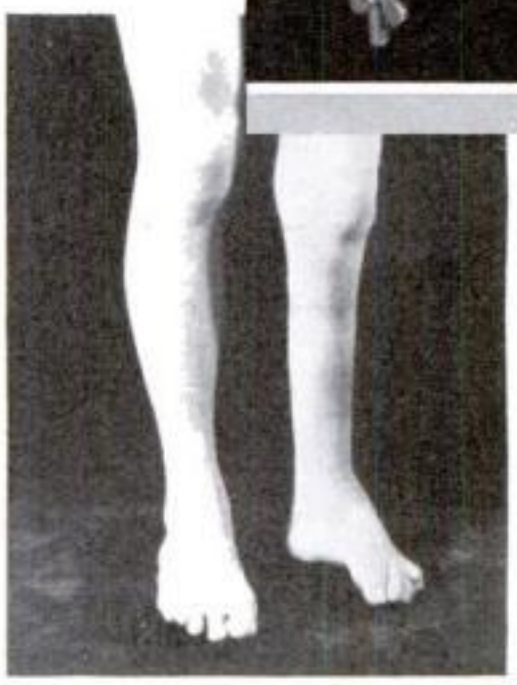


Photo above shows the manner in which bones are cut. Supporting wires driven through the bones are also visible. Worm gears move the carriage which exerts a gentle pull on the bones. Left, a deformed leg that can be given normal length by stretching

MEN AND WOMEN, who once limped painfully through life because infantile paralysis or other disease had left them with a shrunken leg, now walk and work and play with all the ease and grace of normal, healthy human beings. A miracle of modern surgery has achieved for them the amazing feat of actually restoring the length of the deformed leg.

These astonishing cures are effected by a remarkable operating technique perfected by a famous New York orthopedic surgeon. Work on the method was pioneered by Professor Putti of Italy and it was later improved by a St. Louis physician but there was no dependable and accurate way of stretching the leg. The New York surgeon's development of an ingenious instrument provided the means of controlling the stretching process. The new operation is one of the most delicate and exacting ever attempted. So far as known the latest technique is used only at the Hospital for Joint Diseases in New York City. In addition to the manual dexterity of the surgeon, the assistance of nature is required to make the operation a success. The surgeon cannot stretch a bone; he can only cut it. The new bone tissue which gives the leg its added length is produced by nature.

Dividing the bones in the leg demands the utmost care and skill. The bones usually severed are the fibula and the tibia of the lower leg. Sometimes the femur of the thigh is severed but this is done only when maximum lengthening is desired.

To sever the bones, an incision several inches long is made in the leg, starting about three inches above the ankle in the case of a lower leg operation. The patient is, of course, under complete anesthesia during these steps.

Next, the fibula is cut obliquely. Then four short pieces of stiff piano wire are driven horizontally through the tibia. Two of these wires pierce the bone near the knee, one pierces the ankle section, and the fourth the heel bone of the foot. A long step cut is then sawed in the tibia. The step is made longer than the length that is to be added to the leg, so that when the leg is later stretched the two sections of the bone will never entirely lose contact.

With the patient still under anesthesia, the leg is placed in the stretching instrument. This has three upright arms on each side. The wires protruding horizontally from the leg are made fast to the arms.

The incision is closed and the patient put to bed. The wound is permitted to heal for five or six days before the stretching process is begun. Then by means of a screw action in the base of the instrument, the severed bones are gradually drawn apart. A sixteenth of an inch is the most the bones can be moved in any one day without impairing the success of the operation. This gradual separation can be made in most cases, without causing the patient any pain.

At this point, nature assumes the leading role in the drama. The mysterious power of bone structure to reproduce itself enables the severed bones to close up the space between the ends as they are drawn apart. At the maximum stretching rate, about two inches of new bone will be produced in a month.

When the bone has reached the desired length, the apparatus is removed and the leg placed in a plaster cast until X-ray examinations show that the new bone tissue is able to support the patient's weight. At this time the wires are withdrawn from the bones. This is a simple procedure and is done without an anesthetic. The cast is worn for a while longer, but the whole operation from the time the incision is made until the cast is finally removed consumes only six weeks. So far, the operation has been performed only to overcome the effects of disease or deformity, but there is nothing in the procedure that would prevent its being used on a normal person who wished to increase his height and who was willing to undergo the necessary, long drawn-out operation on his bones.

• SPLIT-SECOND DECISIONS SAVE

MOTOR-CYCLE Speed Demons

This is what thrills the spectators at motor-cycle races. The machine seems to be almost touching the track and yet it is skidding around the turn, wheels at right angles, at forty miles an hour

MOTORS roared down the 200-foot back stretch. I started into the turn, going into a wide broadside. Behind me, not more than six feet away, Miny Waln slid into the turn with power on. My rear wheel churned the cushion on the track, I lost control, and laid my motor cycle down in a heart-stopping crash.

As I stretched out, eating dust, but hanging on to my handlebars, my first thought was that Miny in a split-second would strike me and hurtle into the crash wall, injuring me and perhaps killing him. But in that instant, surely not more than a tenth of a second, he crimped his wheel and slithered around on the outside. In nearly the same situation a few nights later, Byrd McKinney laid his motor down on a turn and Cordy Milne roared past on the inside.

Split-second decisions have saved many of us from serious injury in this newest of motor-cycle sports, sliding and broadsiding around the four sharp corners of these triple radius dirt tracks. We dash down the brief straightaways, changing angles twice around each end as we ride our light but powerful motors sideways and take unbelievable chances just to hear the roar of the crowd.

Broadsiding makes possible these high speeds. Only during the last two years have American riders become really skilled in putting their motors into fast power slides, as they take sharp turns with the rear wheel churning the earth.

With a well-balanced motor and sturdy frame, I can ride my machine sideways at high speed with the front and rear wheels turned at right angles to each other, and usually without real danger. Any experienced rider can do this. I find myself fighting two powerful forces as I broadside, one (centrifugal) tending to force me to the outside, the other (centripetal) pulling me toward the pole. Between contending forces, lies a delicate balance which must be maintained or motor and rider will carom off the track and crash into the fence or grandstand.

Broadsiding has won many races for me in England, Germany, France, Scotland, Australia, and South America. Those victories won for me the title of International Champion. Broadsiding gives the customers thrills and me chills, and occasionally this method of making turns has brought serious injury to daring riders.

Though different riders have various ways of going into a turn, here's how I do it after much experience:

I come down the stretch fast, leaning into the turn. My wrists and arms hold the front wheel in line with the rear. At the turn when the rear wheel starts to slide, I slap the power on and, because I am leaning, this fans the rear wheel farther toward the outside of the track. Consequently I take the turn in a power skid.

In the middle of the skid, my rear wheel may be pointed directly across the track, seeking to force me into the pole, while the front wheel is pointed straight forward on the track. In that awkward and dangerous position, I must hold the motor up off the ground and continue jockeying to maintain my position, ready to open the throttle as I straighten out for a dash to the next turn.

My speed has a tendency to force me to the outside. Normally I can offset this by leaning to the left. Sometimes I lean over too far and save myself only by bracing my left foot or knee against the ground while going forty miles an hour.

When I first tried speedway racing in Australia, before it had been started in the United States, I would go on the track wearing a big leather pad on my left knee and a steel shoe over my left toe. I used both these guards to the limit. If you never tried skidding your knee on the ground at forty miles an hour, you may not realize just how I first felt about this method of getting around corners. Now I have largely abandoned the knee pad, relying on pad and boot to save my leg in case I slip during a power skid.

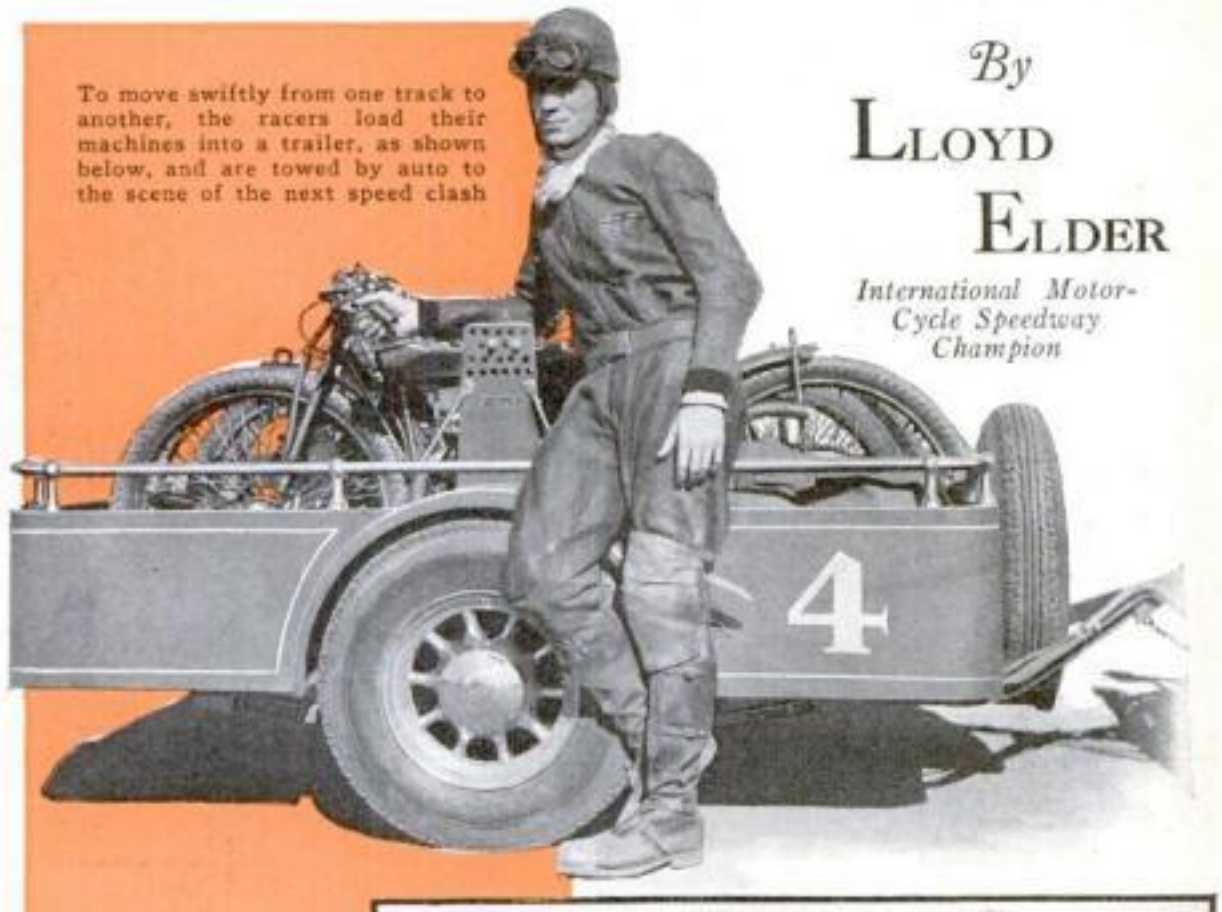
I ONCE thought it took an expert to skid around the semi-circular end of the old-fashioned track. How wrong I found myself to be! Imagine cracking down on what virtually amounts to a right angle turn, only to have to repeat the skid about forty feet later. The triple radius track, which means roughly two turns and a brief straightaway at each end of the fifth-of-a-mile track, requires two sharp broadsides within a long sweeping power skid. My choice maneuver is to come in from the outside toward the center, then start broadsiding in the middle of the curve. I cut the gun at the start of the curve, kick my motor into a slide, and slither almost the whole way around, straightening up momentarily in the middle. This means an almost continuous slide of 200 feet.

All the better riders practice constantly to perfect their form. I have had movies made at the same instant from the inside

Rounding Curves, with One Wheel at Right Angles to the Other, Is Speed Stunt of Reckless Racers in Night Contests on Fifth-of-a-Mile Tracks

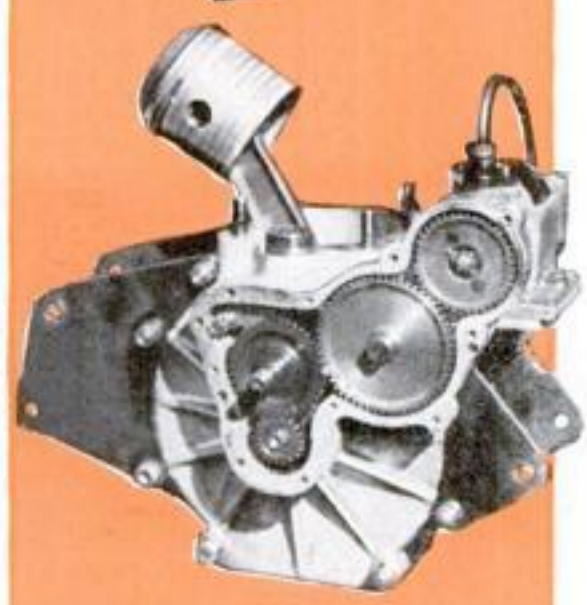
By
LLOYD ELDER
International Motor-Cycle Speedway Champion

Here is the author of this article, wearing his crash helmet which is decorated with a British lion, evidence that he rides an English machine



To move swiftly from one track to another, the racers load their machines into a trailer, as shown below, and are towed by auto to the scene of the next speed clash

Right, a striking picture of Elder making a turn. Note how he uses his left toe to balance the machine while traveling forty miles an hour. Below, cylinder and piston assembly of newest speedway cycle invented by an American



and outside of the track, so I could study my form from both angles. Ray Tauser, an up-and-coming American rider, had still photographs to reveal his form.

From the right, that picture reveals him hanging low over his handlebars, his right foot fixed tightly against the deep-slotted foot rest, well to the rear, and his knee jammed up against the padded hook on the frame, with a trail of dirt spreading out behind from the fanning rear wheel. His distribution of body weight on the machine is excellent.

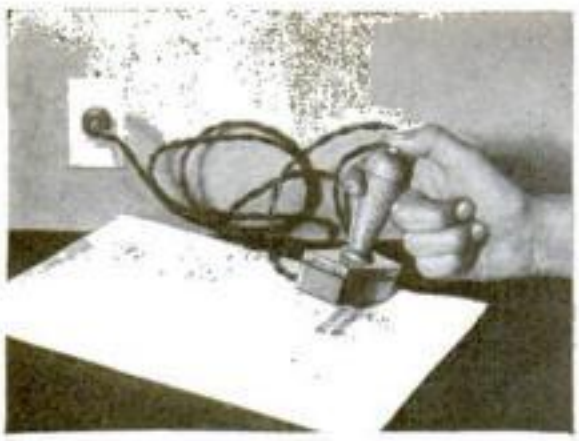
The other view shows clearly the technique of expert broadsiding: front wheel pointed down track, parallel to the pole, rear wheel churning almost directly toward the pole, and Tauser's foot dragging lightly back along the machine, thus adding to the beauty of his performance.

ONLY the most powerful riders can hold the pole during the heat of racing. Byrd McKinney, one of the strongest riders in the game, soon learned the pole is the shortest distance around the track, and managed to win twelve handicap races in a row in California last year. In the handicaps, the faster riders are started in the rear, from a standing start, while in the scratch races, four start abreast with a flying start.

I have tangled with the best of them at home and abroad. In this country Ray Tauser, Miny Waln, Byrd McKinney, Wilbur Lamoreaux, Cordy, Jack Milne, Bo Lisman, and Burton Albrecht probably lead the list. Never have I found one unwilling to take daring chances, hoping to achieve honors leading to the American and finally the world championship. Some ride sitting straight up, others crouch over the handlebars. I seldom stand up, because it detracts from the grace of one's riding form and lessens the feeling of speed. Also, by staying down close to my motor, I generally stay with my machine when it goes down, keeping it between myself and the oncoming riders who are close behind me.

The low-lying rider frequently escapes injury in an accident, though there are exceptions to all rules. Ray Grant hit two riders at full speed on the Oakland track not long ago and was catapulted twenty-eight feet toward the sky. He enjoyed the companionship of a nurse the next month, but returned this season for more punishment. Ray is an interesting rider to watch as he seems to lie flat on the ground when broadsiding. He goes so low, in fact, that I sometimes slow up when following him because I cannot see for a moment whether he has gone down or is still in the race.

Some queer accidents happen. The British cruiser *Delhi* put into San Diego recently and the officers and crew were invited to watch us perform. We performed, all right. I was following Bo Lisman, sailing around the track in good shape when, for no apparent reason, Bo fell off. I hit his machine in mid air and rolled end over end for three complete somersaults. Bo got up and raced again, but after I had (Continued on page 122)



ELECTRIC STAMP BURNS PERMANENT IMPRESSION

USING heat instead of printing ink, a new German device for stamping papers and documents leaves an impression that cannot be smudged or erased. The heat is supplied by electricity from the lighting circuit. When the stamp is applied to paper, a small button on top of the handle is pressed down momentarily closing the circuit. A resistance filament heats the type plate in the base of the stamp, which instantly scorches a permanent brown impression on the paper as desired. A thermostat contained in the stamp prevents the type plate from overheating and thus burning or weakening the paper. Plates carrying various legends and designs can be used interchangeably.

ROBOT PLOWS WHILE FARMER RESTS

WHILE its owner sits comfortably on his porch, a new farm tractor operated by radio control plows his field for him. Radio impulses governing the tractor's movements are supplied by an automatic radio transmitter, and are picked up by an antenna on the tractor. A receiving set starts the tractor's engine, works the throttle and controls the steering. The new robot, exhibited at the Chicago World's Fair, is an improved model developed after earlier experiments.

The radio-controlled farm tractor is demonstrated, above, with a dummy representing the farmer. Left, the transmitting apparatus that guides the tractor

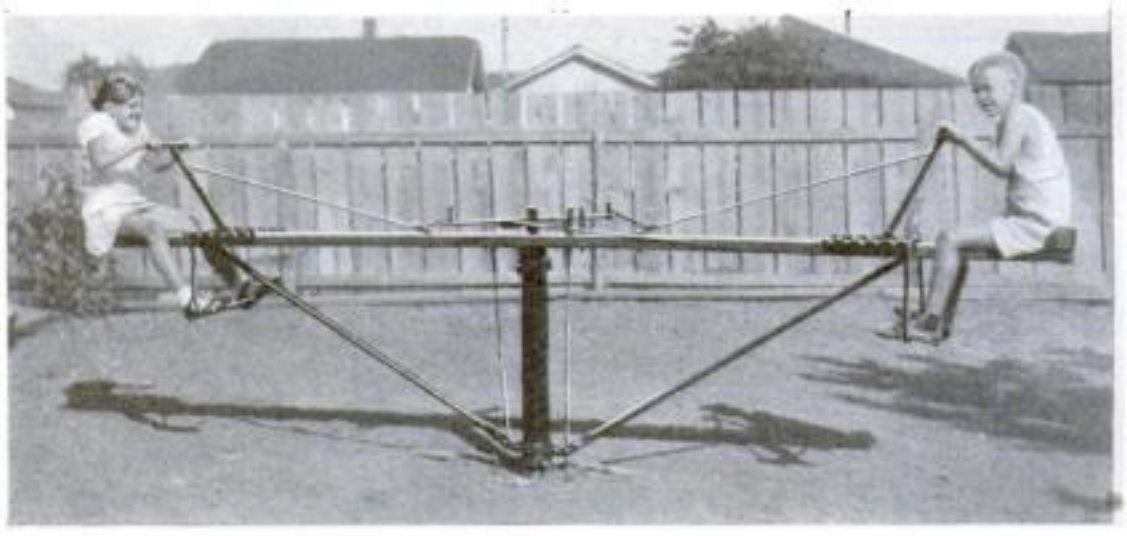
DUTCH HIGHWAY SHOWS SIX MEANS OF TRAVEL

SIX kinds of traffic, so different as to furnish a graphic study in transportation methods, flow along side by side for several miles at a certain point in Holland. Beside one of the many canals of the country run three highways. There is a narrow pavement for pedestrians, a slightly wider one for cyclists, and a broad highway for automobiles. Between the motor highway and the canal runs a double-tracked interurban trolley line, and on the canal itself the slow-moving canal boats glide along in vivid contrast to the speed of the more modern means of transportation. Beyond the canal is a double-tracked electrified railroad. The photograph at the left shows the novel scene.

VITAMINSMADE VISIBLE AT THE CHICAGO FAIR

MUCH discussed and seldom seen are the elusive substances known as vitamins. Everybody knows that they are considered to be essential parts of every diet, but few people have any idea what they look like. Now, however, visitors to the World's Fair in Chicago may see vitamin products in tangible form in an exhibit recently prepared. The four kinds of vitamins, A, B, C, and D, are exhibited in tubes as shown in the accompanying illustration, each tube containing a pure, concentrated sample of the vitamin produced by months of laboratory experiment. It is believed that this exhibit will cause more attention to be given to vitamins.

MERRY-GO-ROUND DRIVEN BY HAND



CHILDREN provide their own power to take an exciting spin on a merry-go-round produced by a Dallas, Texas, inventor. Occupying seats at the ends of a long board, the two children push hand levers back and forth. Wires leading from these handles actuate a ratchet wheel which causes the board to spin rapidly about. The board is mounted on ball bearings on a single support set in concrete. Adjustable steel stirrups are fitted to the board.

AUTO TIRES MADE OF SYNTHETIC RUBBER

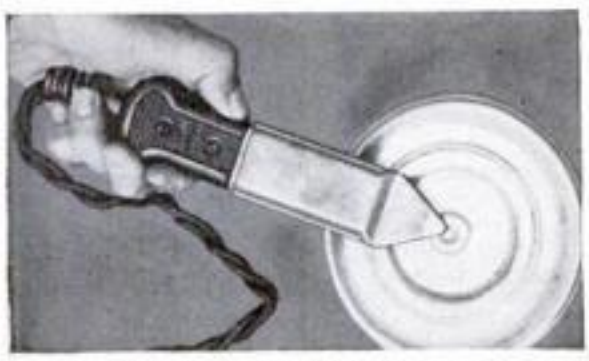
Inner tube of synthetic rubber is submitted to a severe stretching test

SYNTHETIC rubber tires, made from acetylene, salt, and water, have been built and tested successfully by an American firm using an amazing new chemical discovery. All the ingredients of the artificial rubber can be produced in this country. While the new product is far more costly than natural rubber, its discovery frees the United States from dependence upon foreign powers and the possibility of rubber shortage in case of war. In extensive tests, the synthetic rubber is reported to have worn as well as the natural product. The discoveries leading to the development of the rubber were made by the Rev. Julius Arthur Nieuland, of the University of Notre Dame, after many years of effort.

This sawhorse comes to pieces easily so it can be stowed on a shelf out of the way

COLLAPSIBLE SAWHORSE EASILY STOWED AWAY

INVENTED by a Denver, Colo., man, a new sawhorse can be knocked down when not in use and stowed away on a shelf. Although it resembles the ordinary sawhorse in appearance, the cross piece is detachable from the legs. Each pair of the latter is joined by a hinged metal attachment. The metal is so cut as to form a bridge for the cross piece when the legs are set up.



MIDGET SOLDERING IRON

AN ELECTRIC-IRON plug serves both as handle and source of current for a midget soldering iron recently placed on the market. The iron is fitted with a pair of prongs that slip into the holes of the standard plug. House current operates the tool.

GYROSCOPE STEERS TARGET BOAT

TRAVELING forty miles an hour over a fixed course, a pilotless target boat now being developed by the Army will provide a swift, long-range target for Coast Artillery guns. The boat's development is said by the Chief of Coast Artillery's office to be still in an elementary stage, but an experimental model, built by Gar Wood, famous motor-boat racer, was recently tested. Steering is controlled by a gyroscope which is located in the rear cockpit. When the angle of the gyroscope changes as the boat veers from the true course, the gyroscope operates a compressed-air engine, which throws the rudder over and forces the boat back on its course.

Telescope Making Dentists' Hobby

Dr. Charles N. Lord, California dentist, in his shop grinding a telescope mirror

HIS spare-time hobby of building astronomical telescopes gives Dr. Charles N. Lord, of Long Beach, Calif., a chance to make use of the delicacy of touch that he has acquired in his profession of dentistry. Photographing the moon is his specialty, and the high quality of his photographs is due in great measure to Dr. Lord's skill in grinding his reflecting mirrors and to his method of exposing photographic film. Dr. Lord uses a simple box camera and exposes the film by interposing his hand between the two mirrors of his telescope, as at right, before the camera shutter is opened. Withdrawing his hand for an instant, he obtains a one-fifth-second exposure without jarring the apparatus in any manner, resulting in perfectly sharp negatives.

Looking like a gigantic human hand, this skeleton of a whale's flipper was so large three men were needed to carry it

THREE MEN NEEDED TO CARRY MONSTER "HAND" OF A WHALE

SHAPED like a monster human hand, the odd specimen of bone, illustrated at left, recently aroused the curiosity of passers-by when it was carried through the streets of London. The limb is actually the bony structure of a Greenland whale's flipper, and is a part of a skeleton which was being moved piecemeal from one museum to another. Its five terminal bones radiate like human fingers, and one of them, shorter than the others, resembles a thumb. So heavy is the specimen that three men were needed to carry it. Complete skeletons of the Greenland whale are relatively rare, although the species is commonly cited in textbooks as the typical member of its family.

TWISTED NAIL CAN BE DRIVEN INTO CONCRETE

Steel nails, twisted like a drill, revolve when struck and thus force themselves into concrete or steel. They can be used as shown to fasten wood to steel or concrete

WOOD can be attached directly to concrete or steel, without the use of expansion bolts or nailing plugs, by means of a new type of nail. The nail, made of tough steel, comes in lengths up to four inches and is twisted in the manner of a drill. When it is struck, the twist causes it to turn and thus it bores its way into the concrete or steel. Once driven home, the nail remains securely locked in place until it is twisted out.

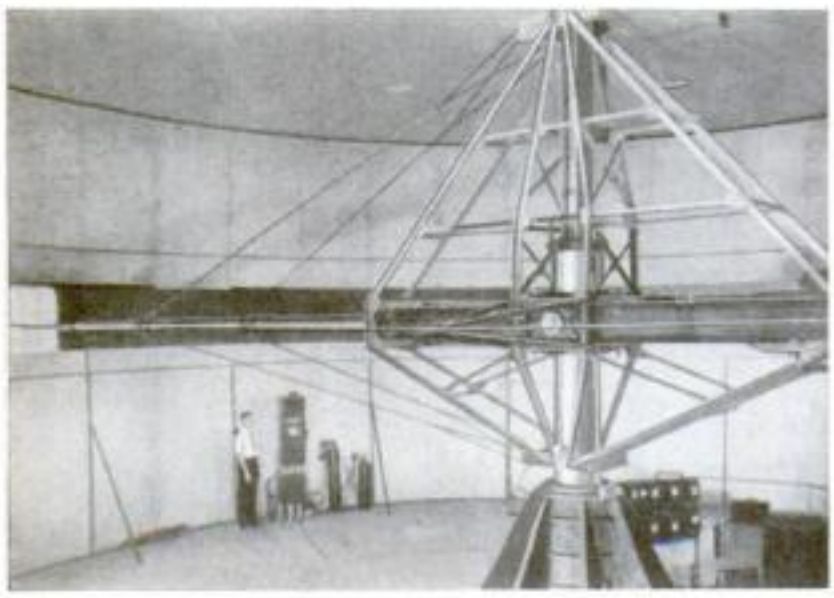
NO FORM FOR CONCRETE PILES

UNUSUAL speed in sinking concrete piles is attained with a new method that uses no forms for the concrete. First, holes are drilled with a motor-driven auger contained in a steel cylinder. Water encountered is drawn off by an electric pump. When the drilling has reached the required depth, the concrete is poured. Thus it hardens before water seepage can dilute the mixture. On a recent operation in Portland, Ore., 256 such piles were sunk at an average speed of sixty-six minutes for each one.

Concrete is poured directly into the hole dug by the motor-driven auger. The edges of the hole, as shown above, prove that no forms are used to hold the concrete while setting

Left, earth chewed up by the auger fills the steel cylinder which is then withdrawn, as shown. Power is supplied by motor truck that carries it

WHIRLING ARM TESTS AIRCRAFT MODELS

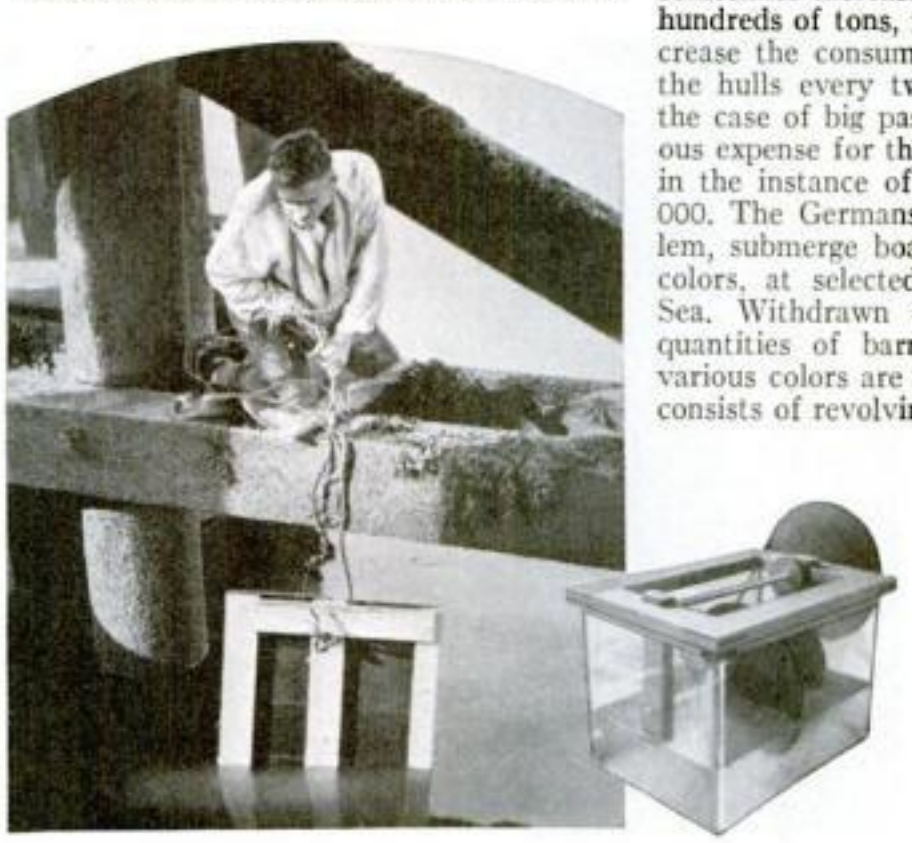


CAPABLE of whirling model craft through the air at better than 400 miles an hour, a new device recently installed at the Guggenheim Airship Institute at Akron, Ohio, provides a spectacular means of testing airplane design. The tubular whirling arm of the device, shown at left, is supported by a heavy upright beam and is braced so models up to twelve feet in length can be tested.

FLOATS IN TANK MEASURE LEVEL OF ANY LIQUID

WEIGHTS in the form of a string of floats actuate a newly designed gage to measure the level of liquids in tanks. The buoyant floats are suspended from the gage and hang inside the tank. When there is no liquid in the tank, the whole weight of the floats is borne by the gage, which registers zero. As the tank is filled, the weight is transferred to the liquid and the marker rises. The new gage will measure all liquids.

NOVEL TESTS AID WAR ON BARNACLES

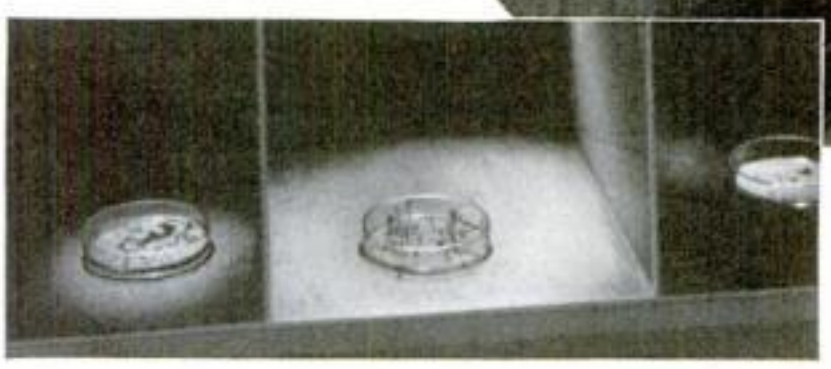


Above, workmen scraping barnacles from the hull of a ship. Center, panel used to test protective power of paints. Right, rotating disk shows how motion affects marine growths

SEEKING a way to prevent the formation of barnacle growths on the hulls of ships, German investigators have established laboratories to determine what colors of paint are most effective in retarding the collection of the pests. The barnacles, by fouling the lines of the hull and sometimes increasing the ship's weight by hundreds of tons, reduce its speed and increase the consumption of fuel. Cleaning the hulls every two years, as is done in the case of big passenger liners, is a serious expense for the ship owners. The cost in the instance of the Leviathan is $50,000. The Germans working on the problem, submerge boards, painted in various colors, at selected points on the North Sea. Withdrawn after four weeks, the quantities of barnacles adhering to the various colors are compared. Another test consists of revolving a wood disk continuously in a tank of sea water. Thus it is seen how quickly the barnacles attach themselves to moving objects, as compared with stationary ones. Americans have also investigated the formation of barnacle growths using white paint to check them.

COLORED LIGHTS WAKE DORMANT SEEDS

RED and yellow light rays have proved a magic wand for waking dormant seeds, in the hands of experts of the U. S. Department of Agriculture. Some seeds have a period of dormancy following harvesting, and sometimes fail to grow properly if planted in the fall. After the seeds had been soaked in water for some time and then exposed to red or yellow light, the dormant phase was found broken. Strangely enough, blue or green light retarded the germination of seeds.



Above, testing effect of lights of various colors on dormant seeds. At left, seeds exposed to red light germinated; others did not

Below, A. G. Law with his nine-inch ship model in its unusual mounting

DAINTY SHIP MODEL HAS RIGGING OF HUMAN HAIR

USING human hair for rigging, and bank-check cancellations for deadeyes, A. G. Law, New York commercial artist, has elaborated upon our plans of the clipper ship *Sea Witch* to produce a model remarkable for the delicacy of its workmanship. The nine-inch miniature is mounted upon a hand-painted map showing the spot where the history-making vessel was wrecked in 1856.

NEW FLIVVER SUBMARINE CARRIES ONE PASSENGER

A ONE-MAN submarine, built by a Chicago inventor, has undergone tests in which it was submerged to a depth of fifteen feet. The strange craft is ten feet long and carries one man comfortably. So that the occupant can see under water, small rectangles of glass are set into the skin of the craft near the bow. The boat is powered by an electric motor, and is made to dive by means of fins attached to either side.

Breeding Dogs

BOTH DOGS BUT DIFFERENT

A giant among the specially bred dogs is this great Dane posed beside a miniature German pinscher bred, by selection, to a tiny size

For years the St. Bernards have been famous for their almost human brains. Selective breeding is expected to give them marked increase in intelligence

A GENIUS AMONG FOX TERRIERS

This super-intelligent terrier, who has demonstrated his talent by counting and selecting colors, is the type that will be used to breed for brains

By
ROBERT
E. MARTIN

A BREED of super-dogs, as remarkable for intelligence as the eighty-odd varieties known today are for their special peculiarities of appearance and usefulness, may be produced by careful mating of animals selected for their mental ability and natural talent.

Dr. William J. Lentz, director of the Small Animal Clinic of the School of Veterinary Medicine at the University of Pennsylvania, believes that the same process of selective breeding that has produced such specialized physical types as the Sealyham and the Boston terrier, can be successfully applied to the development of dogs so superior in mental power as to rank as the Brain Trust of the canine world and form super-dogs.

The American Kennel Club recognizes eighty-nine distinct breeds of dogs. They range all the way from the tiny Chihuahua that weighs as little as two pounds to the lordly St. Bernard that weighs as much as two hundred. Some of these breeds, such as the greyhound, the bulldog and the dachshund were in existence when the world was young. Others, such as the Airedale, the Boston terrier and the Sealyham, are "made" breeds—varieties of dogs evolved by cross-breeding for specialized purposes and now become distinct breeds.

Many dog lovers like to believe that the big, black Newfoundland has a dash of bear blood in him, and that the German shepherd is near kin to the wolf. But scientists agree that all the dogs in the world to-day are descendants of common canine ancestors. Outwardly there is a big difference between a regal great Dane and a yapping fox terrier, and an even greater difference between a high-stepping Irish setter show champion and a hungry-eyed mongrel sniffing around a butcher-shop back door. But those differences are the result of specialized breeding and of environment.

Naturally, dogs bred for many generations for special purposes have developed distinctive characteristics. For thousands of years greyhounds have been bred for speed, and the dogs that to-day chase mechanical rabbits around our dog-racing tracks are but little different from the greyhounds that many centuries ago ran down fleet-footed game for the pleasure of the sport-loving kings of Babylon.

Man, making use through the years of his closest animal friend, has divided dogdom into its eighty-nine clans for his own advantage and amusement. To help him in the business of earning his living he has bred dogs such as the collie and the Old English sheepdog to do the work of herdsmen, the terriers to keep his farms and stables free from rats and other vermin, and the husky to drag his sleds in the frozen North. To help him in his sports he has developed several breeds of hounds, and more varieties of gun dogs. To pander to his vanity in luxurious surroundings, he has produced such toy dogs as the pekingese, which in old-time Chinese palaces was bred in varying colors to match the costumes of the dandies of the celestial courts. By highly selective breeding he has produced dogs that conform to the man-

for Brains

Canine Geniuses Foretold by Scientists Who Are Selecting Intelligent Specimens as Parents of Real Super-Bright Animals

Right, an English bulldog. He is proof of what can be done to bring about physical changes by controlled breeding. Below, an Alsatian, so intelligent he has no trouble learning to go to the help of a drowning man

made standards of their particular breed—dogs of standard size, standard color, and standard physical conformation. He has bred anatomical monstrosities such as the English bulldog. He has changed the natural shape of the heads of dogs such as the collie and the German shepherd. He has changed the color of dogs such as the airedale and the bull terrier.

And while he was very busy doing all that, says Dr. Lentz, he has neglected to breed dogs so as to improve the dog's most valuable quality—his intelligence.

Dr. Lentz is both a scientist and a dog lover. Differences between breeds, though, do not interest him especially. In his eyes dogdom is a true democracy without distinctions of social caste. He finds as many traits to admire in a mongrel as he does in a blue-ribbon winner. All dogs, he says, aren't the same, but the vital differences between them aren't the differences between breeds, but the differences between individuals.

Dog fanciers, Dr. Lentz thinks, put too much emphasis on trying to breed dogs with certain marked physical characteristics, and not nearly enough emphasis on trying to breed dogs of above-average intelligence and helping them develop.

He tells a dog story, a true one, to drive home his idea. One of his friends owns a farm, and on that farm keeps a good-tempered old sow that has become a great deal of a pet. One summer, flies bit the sow's ears so badly that they became raw. To make her more comfortable her owner smeared her ears thickly with lard.

The farm collie was an interested watcher of this act of kindness. When it was finished he walked over to the sow to investigate more closely. The lard smelled good to him, so he began to lick it off one ear. That tickled, and the sow tossed her head. The dog walked around her, and began to lick the other ear. Again the sow tossed her head. The collie took time out to think things over. Then he went into the barn, and came out with a large ear of corn in his mouth. Dropping the corn in front of the sow, he waited until she began to eat it—and then licked the lard off her ears at his ease undisturbed by a tossing head.

That particular collie, it happens, isn't a blue blood. He couldn't win a prize in the smallest dog show. But there can be no doubt about his being a dog of superior intelligence. Dr. Lentz thinks that he should be mated with another dog of superior intelligence. Their offspring undoubtedly would be above the average in dog intelligence. If that system of breeding were continued for several generations of dogs, and the dogs of each generation were given the advantages of careful training and of close companionship with their masters, a breed of unusually intelligent dogs would result. If the system were continued over a long period, always mating the most intelligent dogs, the result would be a breed of superdogs with amazing intelligence.

As the dog is man's closest animal friend, it is much more important that he be intelligent than that he be of a certain color or that his head be of a certain shape. Who wouldn't much rather own a remarkably intelligent mongrel than a stupid prize winner unfit to be a real companion?

There isn't any such animal as a thoroughbred dog. The term "thoroughbred" applies only to horses that are descendants of the Turk and barb stallions and brood mares that were taken to England from the Near East three centuries ago. But there are eighty-nine varieties of pure-bred dogs, and not all of those varieties are remarkable for their intelligence.

Science has proved that there is little or no relation between the size of a man's brain and the power of his intelligence. A small man with *(Continued on page 119)*

This police dog already has enough brains to learn to attack escaping criminals, as he is demonstrating in this picture. Further scientific breeding is expected greatly to improve his talent

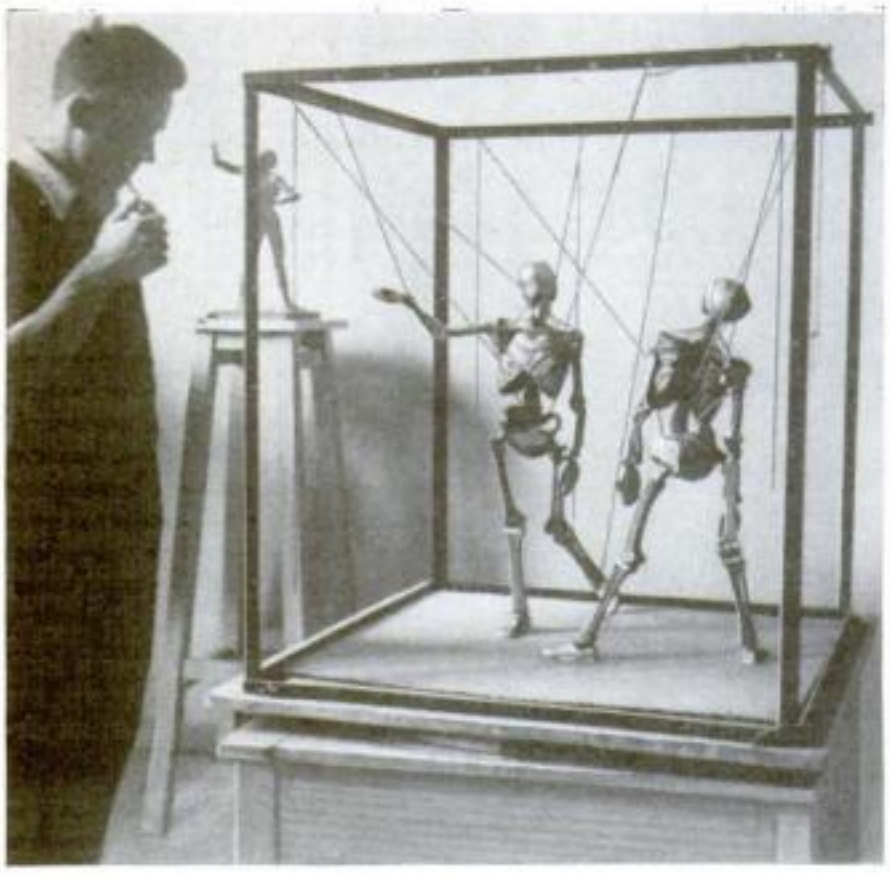
Waterproof Clothes Bag Rides on Car's Roof

Clothes bag for auto folded and carriedbyhandles. Right,opening the bag on the road is easy job

CLOTHING is carried without soiling or wrinkling and without crowding the interior of the automobile, in a new luggage container that lies on the roof of the car. It consists of a heavy, waterproof canvas case that is attached by ropes to the car roof and a lighter bag in which the clothing is placed. The clothing bag is inserted in the protecting case by attaching the handle at one end to the hook of a pull cord inside the case. When the clothing bag has been inserted, the buttons along the end of the case are snapped down making the case dust- and water-tight. When the bag is lifted off the pull-cord hook and folded once, handles at either end permit it to be carried like a suit case, a feature that adds greatly to its convenience as a luggage carrier on auto trips.

The waterproof and dustproof luggage container lies flat on theroof of the car where it does not interfere withpassengers

HUMANLIKE SKELETONS POSE FOR ARTISTS



TO AID students of art and medicine in studying the postures of the human body, a young German sculptor has devised skeleton puppets that can be adjusted to any pose. The figures are made of aluminum, and action of their joints is patterned after that found in the human body. Like marionettes, the puppets are manipulated into the desired attitude with the aid of strings. The illustration at the left shows the inventor of the skeleton puppets viewing a pair of his creations which show all of the bones.

NEW CAR LOCK THWARTS THIEF

USING a cylindrical key, a recently marketed automobile lock for doors or ignition is said to afford protection against thieves. A thief attempting to open the lock would have to pick each of its seven plungers separately. Drilling or shearing off the lock is said to be impossible because of the hardened steel shell. The lock does not bear a number, a secret number being furnished the owner. Duplicate keys can be obtained from the factory only on presentation of the complete lock, which prevents thieves from securing a duplicate key for unlawful use.

MILLION FAKE DOLLARS COINED IN ONE PIECE

WHAT a million dollars in gold would look like, if it were fashioned into a single coin, is shown by a model recently put on exhibition at Chicago. Constructed to scale, the big disk measures thirty-nine and three eighths inches in diameter, and is three inches thick. If it were actually of gold, the massive coin would weigh 1,786 pounds. The picture above compares its huge size with a woman's handbag.

The Man with the Net

ANGLEWORMS *can be dried until they are only forty-six per cent water and then can be revived. But if they become only one-fifth of one per cent dryer than forty-six, they are dead.*

A THIRTY-MILE-AN-HOUR *wind, blowing across a road, exerts a 300-pound side push on a car traveling a mile a minute.*

A MEMORY EXPERT *in Great Britain has sold his head for $5,000. It will be studied by scientists after his death.*

THE CRAWFISH *has an eye in its tail. Discovered by a Harvard scientist, it is sensitive to light but sees much more slowly than the eyes in the creature's head.*

A BEAR'S DEN, *with an inverted periscope, has been built in Yellowstone Park to enable scientists to study the habits of the animals during hibernation.*

AN ATHLETE *with as much energy as an average car going a mile a minute could hurl a sixteen-pound shot nearly ten miles.*

FUNGUS *is fighting fungus in a New Jersey experiment station where scientists are trying to overcome plant diseases caused by parasite growths. Trichoderma, microscopic fungi, are being employed to eat up the destructive growths.*

AN INTERNATIONAL *record collector's club has been formed, with headquarters in Bridgeport, Conn., to foster the hobby of collecting old phonograph records. A New York City supply house specializes in early records for such collections.*

FOR EVERY HOUR *on the air, radio performers practice from five to fifteen hours in the studio.*

SEAGULLS *have a monument at Salt Lake City, erected because they saved early settlers from a grasshopper invasion.*

BEES *are color-blind but they see "invisible" ultra-violet and infra-red rays.*

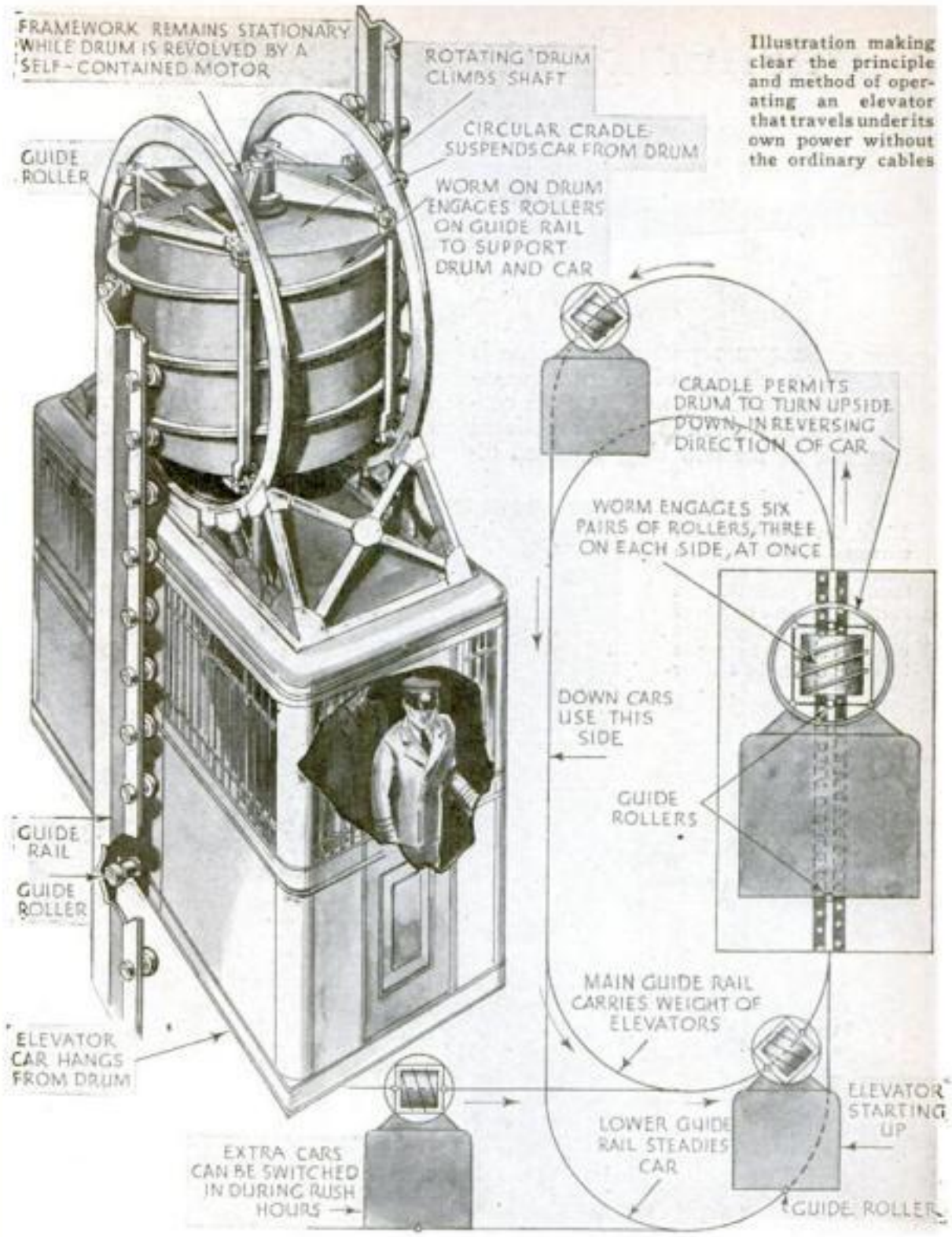


Illustration making clear the principle and method of operating an elevator that travels under its own power without the ordinary cables

NEW ELEVATOR WORKS WITHOUT CABLES

ELEVATORS travel under their own, self-contained power in a system upon which a New York inventor has just received a patent. Each car is suspended from a hollow drum containing a driving motor. Under control of the operator, the drum revolves and climbs a vertical series of rollers by means of a worm on its exterior, as shown in the diagrams. Reaching the top of its endless shaft, the drum inverts itself and starts down the other side, the elevator car remaining upright meanwhile. Advantages of the new system, the inventor declares, are that extra cars may be used during rush hours and withdrawn when not needed; also, that the system removes present restrictions that limit the height of elevator shafts.

CAMERA RECORDS SIGN LANGUAGE

ONE of the strangest of dictionaries is being compiled by the Smithsonian Institution at Washington to preserve the sign language of American Indians. Instead of being written on paper the dictionary is being recorded on motion-picture film. A full-blooded Indian, familiar with the sign language, is seated before the camera and his gestures are photographed. The use of visual language already is little more than a memory, and the motion-picture dictionary is being made for future students.

Richard Sanderville, Blackfoot Indian, talking in sign language before a camera that is making a dictionary

Pusher Plane's Controls Hooked to Wings

This French-designed pusher plane has its controls attached directly to the wings. Three wheels are necessary to help the queer craft make a landing

AN ODD-LOOKING pusher-type plane is the latest contribution of French aeronautic engineers to airplane design. The controls found at the tail in the conventional plane are, in the new ship, attached directly to the wings or to the stubby enclosed cabin. The wings are swept back in a V pattern and rudders are carried at the wing tips. Directly beneath each rudder is a tubular skid that serves the same purpose in landing as the ordinary tail skid. The unusual weight distribution of the craft makes a third landing wheel necessary. This is located under the forward tip of the cabin. The plane is powered by a five-cylinder radial engine mounted behind the cabin. An unusual feature is the absence of a tail.

Right, Dr. T. M. Hall with the two stuffed dummies he used to tame the wild birds that frequented his Georgia garden. Below, a couple of birds so tame they alight on the doctor's hat while he sits quietly in a chair

USES STUFFED DUMMY TO TAME WILD BIRDS

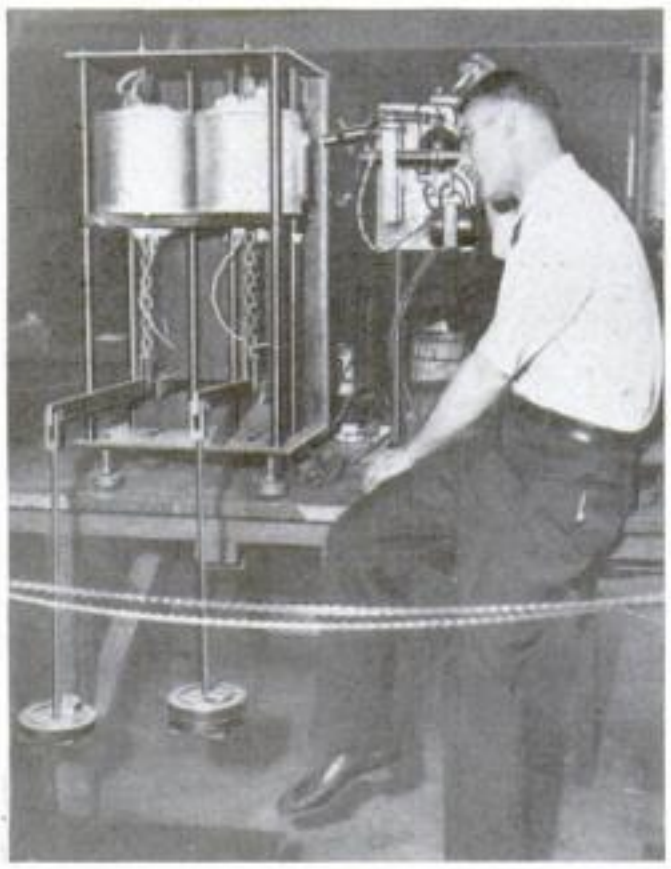
TAMING wild birds with the aid of dummies is the feat of Dr. T. M. Hall, Milledgeville, Ga., physician. He first placed a show-window dummy in his garden. When the birds grew used to it, he substituted an effigy of himself, with a cardboard chest that simulated breathing when he pulled a long string. Finally he himself took the place of the dummy, and found that the birds were not alarmed.

CAMERA FOR MICROSCOPE AIDS AMATEUR'S WORK

WITH a new photomicrographic outfit designed especially for amateur microscope enthusiasts, pictures of specimens can be made easily. The outfit consists of a focusing tube, a light-proof connector, and a box-type camera that swings about a support. The microscope is placed on the base and adjusted until the image is sharp. Then the camera is swung over the eyepiece and the picture is snapped.

SILVER RODS SHOW METAL'S "STRETCH"

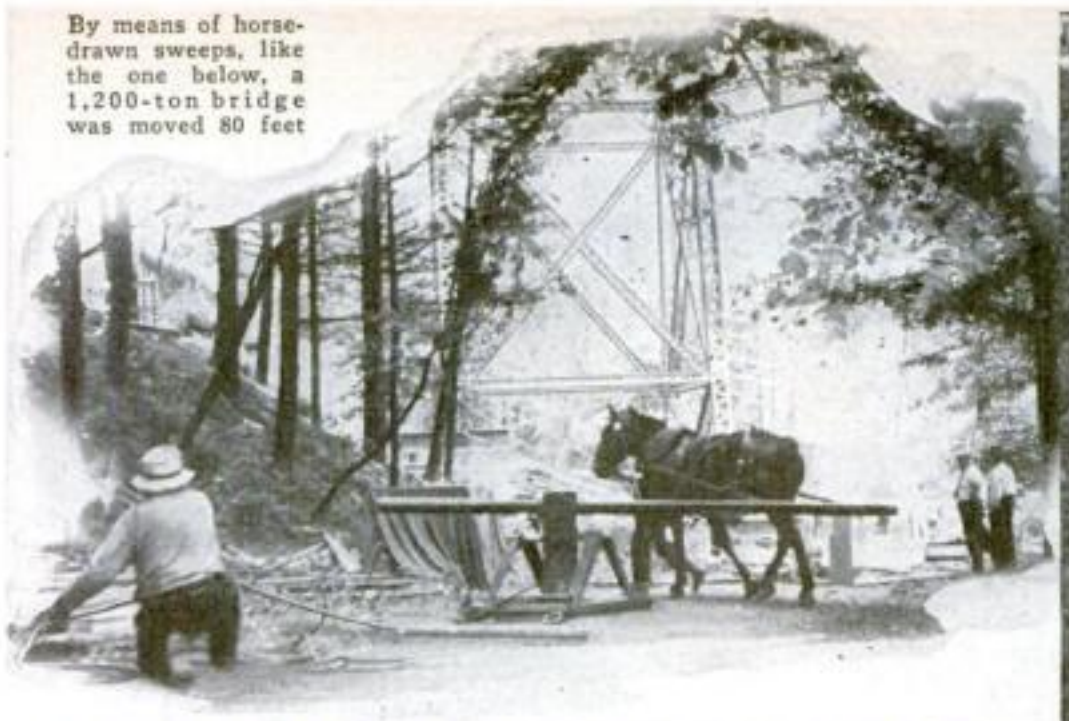
DIMINUTIVE rods of silver, put through third-degree tests at the U. S. Bureau of Standards, are revealing interesting new facts to architects and builders. To study the rate at which metals flow or "stretch" while bearing a load, the rods are weighted and kept for several months in an oven where heat accelerates the stretching. Silver rods are used since they can be cut from a single crystal of the metal.



Weighted rods of silver are placed in this apparatus to study their stretch under a load. Left, silver rods, one longer than the other after stretching

CELLOPHANE MASKS SAVE DOCTORS FROM GERMS

CELLOPHANE masks for doctors and nurses are a recent innovation at a Los Angeles, Calif., hospital. Worn before the face, the transparent shields are designed to lessen the chance of contagion in treating patients with communicable diseases, without obstructing the wearer's view or otherwise inconveniencing him. The masks may be donned or removed in an instant, and are either worn with a headband or clipped to the users' spectacles, as shown in the illustration.



By means of horse-drawn sweeps, like the one below, a 1,200-ton bridge was moved 80 feet

Air picture of the bridge at its new location after being moved successfully from old site

HORSES MOVE 1,200-TON BRIDGE

ENGINEERS recently succeeded in moving a 700-foot bridge, weighing 1,200 tons, a distance of eighty feet. The bridge is the forty-three-year-old structure that carries Calvert Street over a ravine in Rock Creek Park, Washington, D. C. At its new location, it will carry the Calvert Street traffic while a new bridge is being built. First miniature railways were laid under each of the five steel piers. Rollers, carrying huge timbers, were laid upon these rails and the bridge, by means of jacks, was raised from its foundations. Steel girders were then slipped under the structure and its weight was transferred to the roller-borne timbers. Horses, turning great winches, pulled the bridge to its new location.

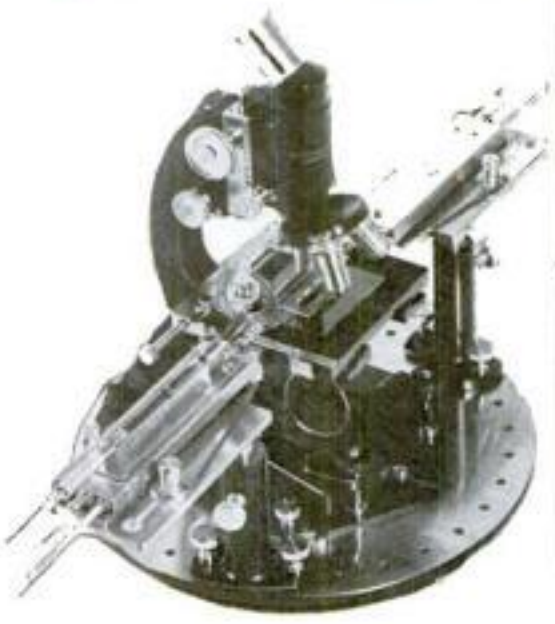
Photo shows one end of the bridge cut loose and ready to receive the rollers upon which it was moved

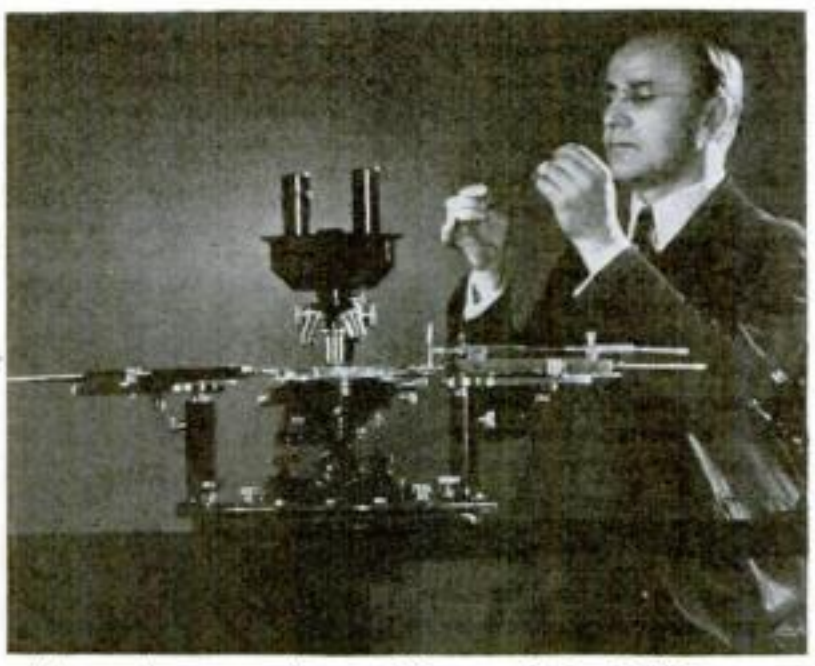
NEW LEG SHACKLE HOLDS RUNAWAY PRISONERS

A NEW leg shackle that automatically disables a prisoner who tries to run is being tested by the U. S. Division of Investigation. Invented by a seventy-three-year-old Louisiana farmer, it consists of two hinged steel rods, bound to the thigh and lower leg by padded chains. As a prisoner bends his knee sharply in attempting to run a ratchet mechanism in the hinge automatically locks, preventing him from again straightening the leg.

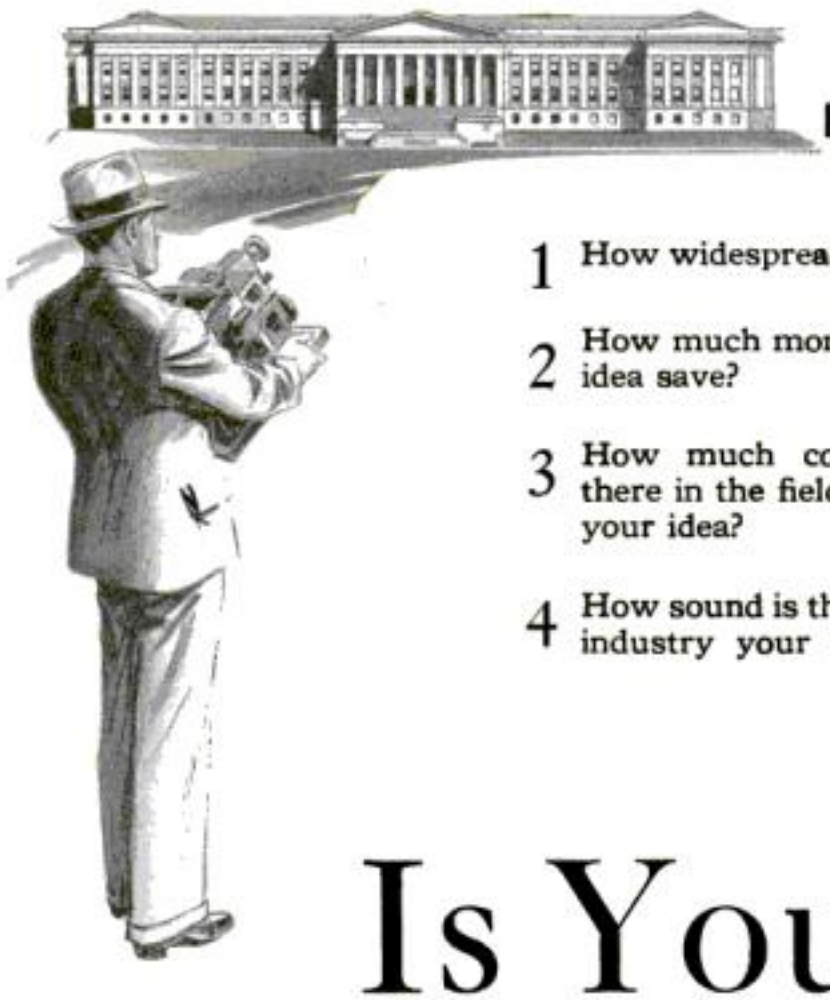
MICROSCOPE DEVICE AIDS CELL STUDY

TINY quantities of fluids may be injected into a single living cell, such as a blood corpuscle, with the aid of a new attachment for any standard microscope. Thus the cell's reaction to poisons, anesthetics, and saline solutions can be watched at close hand. A cell may also be dissected beneath the lens, with the aid of glass needles operated by hand screws. The attachment is a versatile form of an instrument known as a micro-manipulator.





Above, using new micro-manipulator to inject fluid into a cell specimen for microscopic study. Left, close-up of device



8 TESTS THAT SAVE INVENTORS TIME AND MONEY

1 How widespread is the need?

2 How much money will your idea save?

3 How much competition is there in the field affected by your idea?

4 How sound is the basis of the industry your idea affects?

5 Will the change be too sudden for the public?

6 How much will it cost to put your idea on the market?

7 Is the idea enough of an improvement to warrant installing new machinery and scrapping that already in use?

8 Can your invention compete in price with rival products?

Is Your Idea Worth Patenting?

By **CHESTER A. WEED**

IF YOU tried to sell an Eskimo an electric fan, a South Sea Islander a sled, or a Sahara sheik a motor boat, the world would think you crazy. Yet, in effect, that is what amateur inventors are doing every day of the year. They are spending their time, their money, their energies inventing things nobody wants and for which nobody will pay.

Not long ago, one of my clients came to see me about getting a patent on a new kind of notebook. She was a woman who had taken out more than thirty patents over a period of years. I asked her if she had made any money out of them. She seemed surprised. "No," she said, "I never made a cent. But I think if I get enough patents, one may make me rich."

That has been the attitude of many inventors I have met in the nearly fifty years I have been practicing patent law. They have been inventing aimlessly, fumbling for the keyhole in the dark. And in the end, they have been disappointed in their expectations and have concluded the game is not worth the candle.

In fact a recent survey shows that a high percentage of all inventions never pay back the costs of getting the patent. This, I believe, may be traced largely to the fact that inventors so often fail to analyze the market and the demand for their ideas before they go to the trouble and expense of patenting them. This precaution should never be omitted.

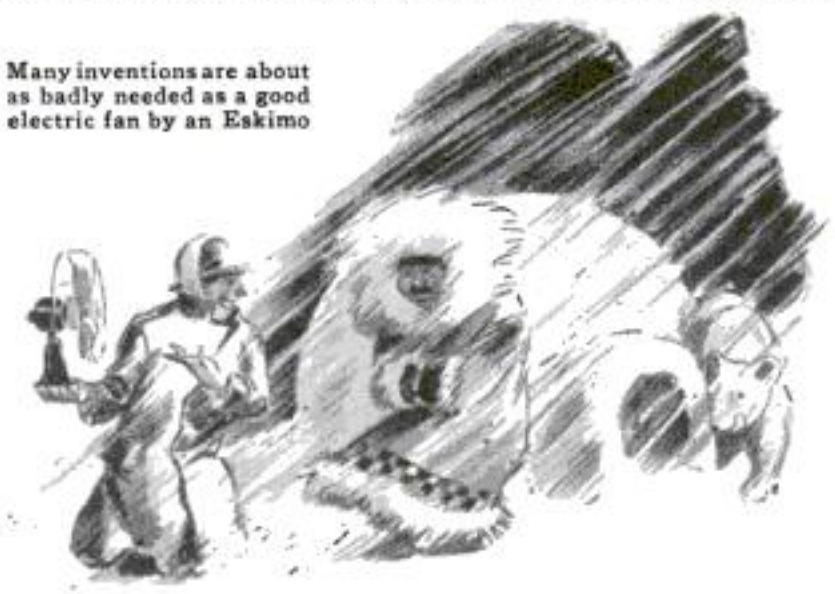
In the hope of helping beginners avoid wasted time and money, I am setting down eight tests for estimating the demand for an invention and the prospects of making money from it. In the first place:

How widespread is the need?

The ideal invention, of course, is something everyone will use all the year around. Rubber heels, clothespins, mamma dolls, shoelace tips are universal inventions that have made fortunes. A new kind of coconut grater for housewives or a new kind of doll for children will have more chance of profit than an automatic rhymer for poets or a clawproof coat for lion-tamers—for the simple reason that housewives and children outnumber poets and lion-tamers. If your idea fits in the home, in business, or in an important branch of manufacturing, its chances of making money are greater than if it is confined to the theater, the golf links, or the shooting gallery. Ask yourself the question: What class of people will need my invention and how large is the group comprising the class?

If your idea is an improvement on an article already in use, find out how many of these devices are sold annually. If it is an entirely new development, ask experts in the branch affected by it, without telling them the details of the invention, what the demand would be for the idea if it actually does what you claim it will do.

One invention for which there has been a wide demand for years is a non-refillable bottle. A standing offer of $1,000 has been made by one hair tonic concern for such a container as



Many inventions are about as badly needed as a good electric fan by an Eskimo

it would prevent refilling the bottles with counterfeit products.

Hundreds of patents have been taken out on such bottles. Some have trick valves at the top; others a labyrinth of channels winding through the solid glass of the neck. In both cases the idea is to allow the liquid to flow out but not in. So far, however, all of the attempts have been either unsuccessful, too costly, too easy to tamper with, or too hard to manufacture and fill. The rewards are still open for the man who can solve the problem in a cheap and simple way.

Another way of estimating the need is to check up on the frequency with which the device is likely to be used. If it is something that is needed a dozen times a day, it is a better bet financially, other things being equal, than if it is used once a week or only on the Fourth of July.

One striking exception to this rule was an involved mechanism upon which I once helped an inventor obtain a patent. He had worked for years upon it although it was designed to be used only once in a decade. It is employed to sort and file statistics during a census. Although its use is not widespread, its high-speed, time-saving features during the rush work are worth vast sums to the government. Its value lay in the way it answered Test Number Two, namely:

How much money will your idea save?

If you invent a machine that turns out the same article at half the cost, you will have no difficulty interesting manufacturers. However, if you invent an article that will wear twice as long, the result may be another story.

A number of years ago, a new kind of non-skid chain appeared on the market. It was designed with solid links across the tread of the tire so it was almost impossible to wear it out. Another concern sued the manufacturer and in court was able to obtain a decision preventing the sale of the new chain as an infringement on a prior patent held by them. But afterwards, no one ever manufactured the superior chains. They disappeared from the market. They wore too well, so well

You could hardly expect a desert sheik to get excited over this

motorists did not need to buy new chains for many, many years.

It is well for an inventor to keep in mind, when determining whether his idea is likely to prove profitable, that just because it is an improvement does not necessarily mean it will be welcomed by manufacturers. An idea may be a good idea, a valuable idea, and yet an idea nobody wants. Manufacturers are in the business of selling certain merchandise. They are not apt to welcome innovations which reduce the market for this merchandise.

Puncture-proof tires, having all the qualities of present-day tires, for example, would be welcomed by motorists, but probably not by tire makers. They would cut down the demand for tires by lasting too long. Some have already been invented, but they are not on the market.

In an industry where the competition is keen, there is always a better chance of finding a concern to accept your idea. In fact, Test Number Three for estimating your prospects of making money from your idea is:

How much competition is there in the field affected by your idea?

If your invention is intended for use on automobiles, for instance, you have a wider market than if it is to be used on cameras, for there are many more motor-car makers in America than manufacturers of cameras.

Probably the best example of the importance of this factor is the case of Adrian de Piniec-Mallet, a French boarding-house keeper in New York City.

Early in the present century, he came to my office with drawings of a new kind of bed. In his boarding house he had been using single beds in small rooms. However, often double beds were needed and after working on the idea for some time, he finally produced what proved to be the father of the modern day-bed which can be opened into a double bed at night and contracted into a single one in the daytime.

Six feet, two inches is the standard length for beds. Mallet took two wooden cots, with spring fabrics stretched between the ends and cut an inch or so from the end of one. This permitted it to slide in between the endboards of the longer cot. By substituting rollers for legs on the inner side, he produced a bed that would telescope in, at the same time keeping the spring fabrics or tops of the cots substantially level with each other. Because mattresses of the same thickness could be used on both cots, the Mallet bed was a great improvement over the old trundle bed in which the smaller of the two beds was much lower than the larger one.

The idea seemed so obviously of value to him that he thought the first manufacturer he approached would snap it up. But, although the beds made a fortune when they did appear on the market, Mallet had to argue with many different manufacturers in New York, Boston, and elsewhere before he found one with sufficient insight to see the possibilities *(Continued on page 120)*

Selling a sled to a South Sea Islander would be a cinch as compared to the job of finding a market for some ideas that uninformed inventors try to develop

Microbe Hunting WITH YOUR MICROSCOPE

LIGHTING A MICROBE SPECIMEN

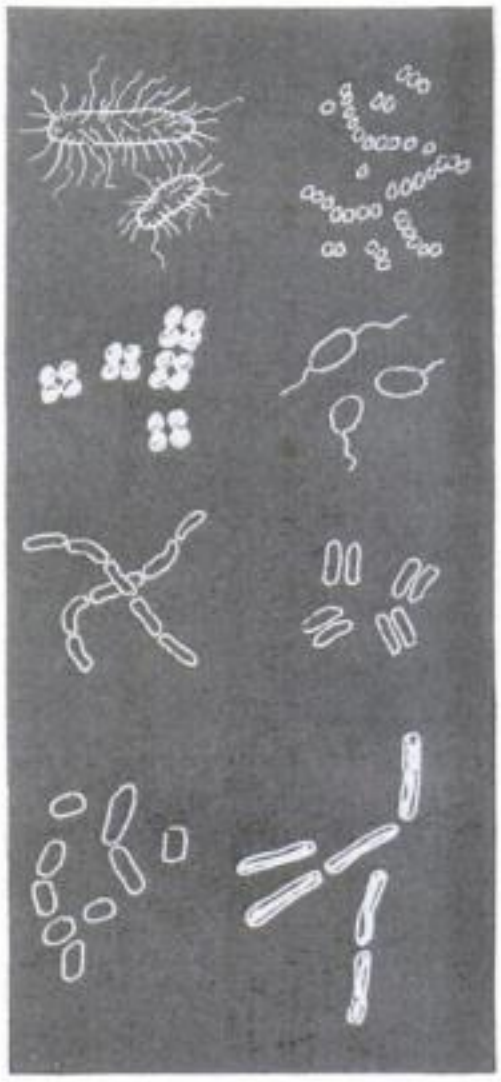
Having mounted a solution containing microbes, as described in the text, the slide is placed beneath the lens and illuminated by an enclosed and directed light as is shown in the illustration above

IF THE microscope could make visible nothing except the tiny plants known variously as bacteria, microbes, or germs, it still would deserve its position as the leading tool of modern science. In the first place, it was the microscope that revealed the presence of these organisms and made possible the researches that showed them to be plants rather than animals. By magnifying bacteria in milk, meats, and canned goods, the microscope helps to prevent the sickness that results from poisons. By revealing germs occurring in the blood, waste matter, or stomach contents of sick persons, it enables physicians to identify diseases and wage successful battles against them. This magic instrument also has been used to make visible, in coal and other fossil remains, germs that lived millions of years ago!

There probably is as much variation in the sizes of bacteria as there is in plants of the garden or field. Scientists have reason to believe that there are vast numbers of microbes so small that they never will be seen through the microscope, at least not through one that works on present optical principles. On the other hand, there are many varieties of bacteria that are, when compared with others of their kind, very large: so large they can be seen through the average amateur microscope that magnifies a few hundred diameters.

You cannot simply train your microscope upon a drop of stagnant water or a bit of decaying meat and see the bacteria that are living in it. You have to go about this business of microbe hunting systematically, employing stains and special methods to render the tiny germs visible. After you have gone through the process once, you will be surprised at the speed and ease with which you thereafter can stain and mount bacteria for observation. You will find this process one of the most fascinating in microscopy.

Equipment for a microbe hunt does not have to be elaborate. A few clean slides and cover glasses; some denatured or, better still, absolute ethyl alcohol; a bottle of Loeffler's methylene blue stain; some liquid petrolatum or Canada balsam for mounting, and the usual tweezers, medicine droppers, and glassware used in most slide-making operations, are about all that you need to secure slides of bacteria.



FORMS OF BACTERIA. Here are two of the commonest forms of bacteria and those you will be most likely to encounter. The rod-shaped ones are bacilli and the spherical ones are cocci. Others spiral in shape are called spirilla

• HOW TO PREPARE, STAIN, AND MOUNT A

1 Preparing bacteria for observation under a microscope. A small quantity of bacteria material is smeared on a slide

2 When the smear is dry, alcohol is burned to fix it

How to Find Germs, Mount Them, and Study Their Life History Beneath Your Lens Is Clearly Described Here

By

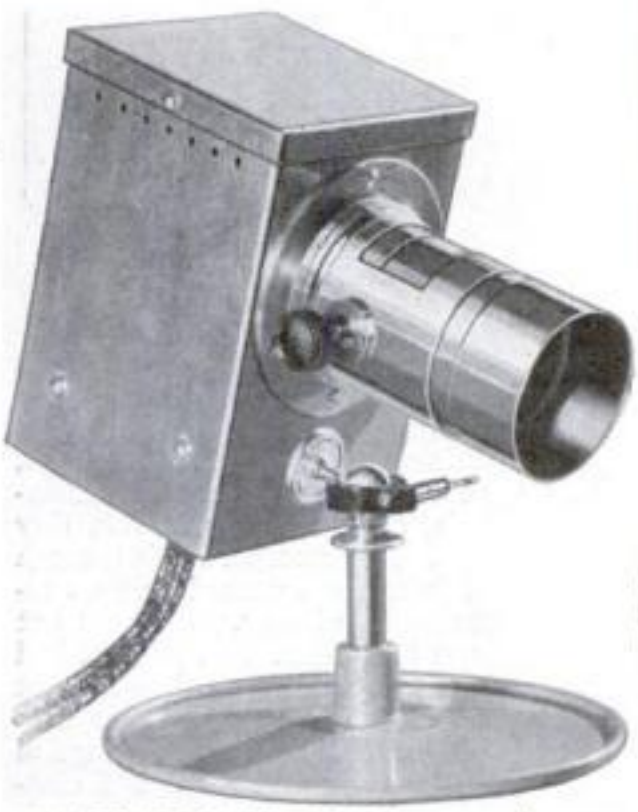
Morton C. Walling

You can find bacteria almost anywhere. Your mouth is swarming with them. The water of the fish bowl has hundreds of them in every drop. They are present in milk, buttermilk, cheese and, of course, in spoiled foods in great numbers and are easily found and mounted.

Your mouth is a fairly well-stocked botanical garden, as the following procedure will demonstrate:

Lay out one or more clean glass slides and cover glasses. Incidentally, a "clean" slide does not mean one that merely is wiped a few times with a cloth. You must remove every trace of dirt and grease, particularly grease, if you want the best results. A simple method of cleaning a slide or cover glass is to wash it first with soap and water and then scour it with a greaseless household cleaning agent. Finally, polish the glass with a clean cloth such as a well-washed linen towel. When the glass surface is perfectly clean and free of grease, a drop of water placed on it will spread out into a thin film. It is a good idea to pass the polished slides and cover glasses two or three times through an alcohol or gas flame, just before using, to remove traces of grease. Be careful not to hold them in the flame long enough to cause warping or cracking.

Touch the tip of your tongue lightly to the center of one of the clean slides. Allow the spot of moisture to dry, or heat the slide gently to hasten drying. Lay the slide face up—that is, with the side to which you touched your tongue, uppermost—on a watch glass or other support. Let a drop of alcohol fall on the center of the slide. When it has spread out into a thin film, strike a match and touch the flame to the edge of the alcohol layer. The burning alcohol fixes the bacteria that were transferred to the slide surface from your tongue. In other words, the treatment kills the germs and preserves them in their natural form.



HOMEMADE LAMP. This laboratory microscope illuminator was made largely from odds and ends. It is powerful enough for high-powered magnification. Instructions for making given in the text

YOUR OWN BACTERIA. Touching the tip of the tongue to a slide deposited the bacteria seen in circle. The dark oval spot is the nucleus of a dead cell

Loeffler's methylene blue is a satisfactory stain for coloring bacteria. You can purchase this preparation at biological supply houses and some drug stores, or you can make it as follows:

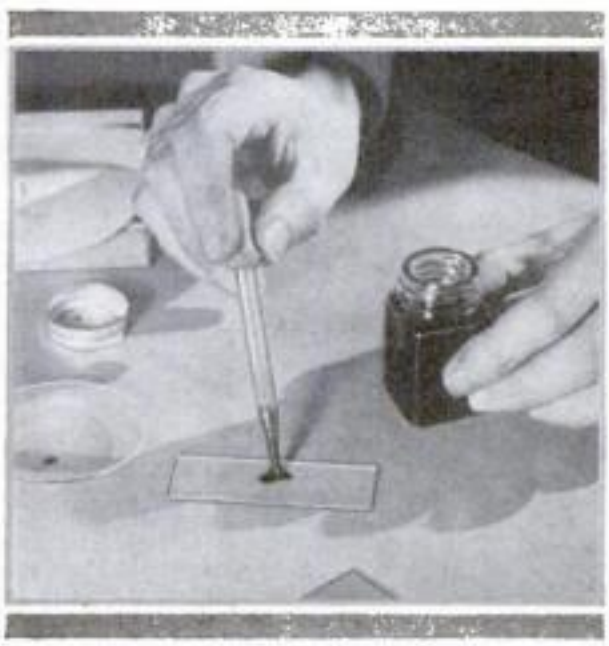
Add to thirty cubic centimeters of alcohol all the methylene blue it will dissolve. Mix this with 100 cubic centimeters of distilled water to which has been added two drops of ten per cent potassium hydroxide solution. (To make a ten per cent solution of potassium hydroxide or any other salt, mix one ounce of it with enough water to make ten ounces of solution). You will find this stain useful in preparing all kinds of specimens for the microscope.

Place one drop of the methylene blue solution on the material to be stained and let it remain for one to two minutes. You may get better results by diluting the stain with three or four times its volume of water, and letting it act for a longer time.

Wash the stain off by letting tap water run over it, and dry the slide. A quick and easy way of removing the water is to use a sheet of filter paper as a blotter, being careful to *press* it against the specimen, and not to wipe it across the glass. It will pay you to become acquainted with filter paper, for it can be used for many things in the microscope laboratory, its chief value of course being as a filter for stains and other solutions from which you desire to remove solid particles.

Although the slide can be examined as it is, it usually is desirable to add a cover glass that is held in place by a mounting medium. For this medium you can use Canada balsam, the result being a permanent slide. Some expert microscopists prefer liquid petrolatum, an oily substance that is said to have better optical properties than balsam. You can obtain it from a druggist. Ask for the heavy grade, in a dropper bottle. Place a small quantity of the petrolatum, just enough to spread out evenly beneath the cover glass, on the stained specimen, and add the cover glass. There should not be enough of the petrolatum to ooze out around the edges. If you

BACTERIA SPECIMEN FOR OBSERVATION UNDER YOUR MICROSCOPE •



3 Loeffler's methylene blue preparation is applied for two minutes to stain the specimen

4 After the stain is washed away with clean water, the slide is dried with filter paper

5 A tiny bit of petrolatum is placed on the smear. Add cover glass and specimen is ready

want to make the mounting permanent, simply apply with a small brush gold size about the edge of the cover glass.

You probably will not be able to see anything on the slide when you examine it with your naked eye, except perhaps a slight blueish tint; but when you examine the slide with your microscope, at a magnification of 250 to 500 diameters, you find that your mouth contained more than teeth.

The large, irregular stained patches that are visible in the microscope field are bits of tissue or food that were in the saliva. In addition you see a lot of little specks. Some are round, others are two or three times as long as they are wide. You move the slide a little. Here is something! A dozen or so little balls are strung together, like beads on a string; and here is another string, but the beads are rod-shaped instead of spherical.

These isolated specks and strings are bacteria, the tiny plants that were in your mouth. Probably most of them are harmless, because your mouth normally is swarming with them. Probably, too, some of the germs are of the pathogenic or disease-producing type. But do not let that worry you, for the average healthy mouth contains many harmful bacteria that are prevented from doing damage by the normal resistance of your body.

If your microscope does not reveal the bacteria distinctly, try improving its performance with filters, or by adding a substage diaphragm as described in a preceding article, (P.S.M., June, '34, p. 40) if this useful accessory is lacking. Perhaps a different stain, such as carbol fuchsin, will work better in some instances. After you have determined what to look for, you can distinguish bacteria with a magnification of only 100 diameters. A good rule is to look first for the chains of rods or spheres.

You can find bacteria almost anywhere, by following the preparation method outlined. In some cases it will be necessary to introduce variations. For example, in the preparation of milk specimens, which make excellent subjects for the amateur, you must remove the fat and manipulate the stain so that the best contrast is produced.

Preparation of milk for bacteriological examination can be outlined in steps as follows:

1—Make a thin smear of milk or cream on a slide.

2—Dry gently over a flame.

3—Cover the specimen with a few drops of xylol for two and one half minutes, and then drain off. This removes the fat.

4—After xylol has evaporated, add several drops of acetone and let remain for about three minutes. Instead of acetone, you can use alcohol for two to five minutes, or until the smear has lost its milky appearance and become clear.

5—Stain with Loeffler's methylene blue for about two minutes. Rinse in ordinary water.

6—Cover the smear with alcohol for one minute. This bleaches out some of the stain, affecting that in the bacteria less than in surrounding material.

7—Mount in liquid petrolatum or other medium.

8—Label, listing source of material, stain used, and results obtained.

BACTERIA FOUND IN MILK. In the upper circle are harmless bacteria in Pasteurized milk. Above, buttermilk bacteria

The presence of bacteria in milk does not mean that it is unfit for use. Dairy companies make no attempt to remove all bacteria for the simple reason that it would be impractical if not impossible. They simply strive to keep the number down to a safe maximum. Probably, too, many of the bacteria you observe in milk were killed by the Pasteurizing process.

You will find it a fascinating adventure to look for germs in all kinds of materials. If you happen to cut your finger, make a blood smear and stain it to reveal the bacteria. Perhaps you will be lucky enough to find a white blood corpuscle that has devoured a number of germs. It is by such means that the white corpuscles rid your body of disease-producing organisms.

In examining the juices of canned fruits, you may encounter tiny specks that resemble bacteria, but which are in fact tiny yeast plants. A microscopic cruise through a drop of juice from canned peaches revealed thousands of tiny yeast cells but not a single bacterium. The peaches had been opened several days before, but showed no signs of spoiling. Later they fermented. Generally you can distinguish yeast cells by their oval shape and comparatively large *(Continued on page 110)*

MAKING A LIGHT FOR YOUR OWN MICROSCOPE

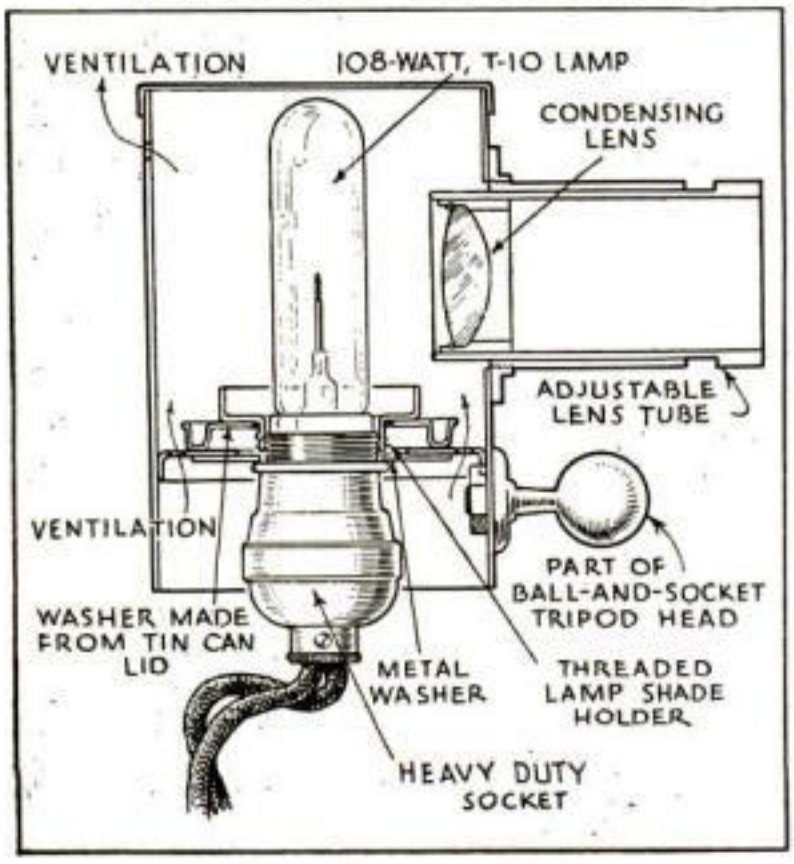
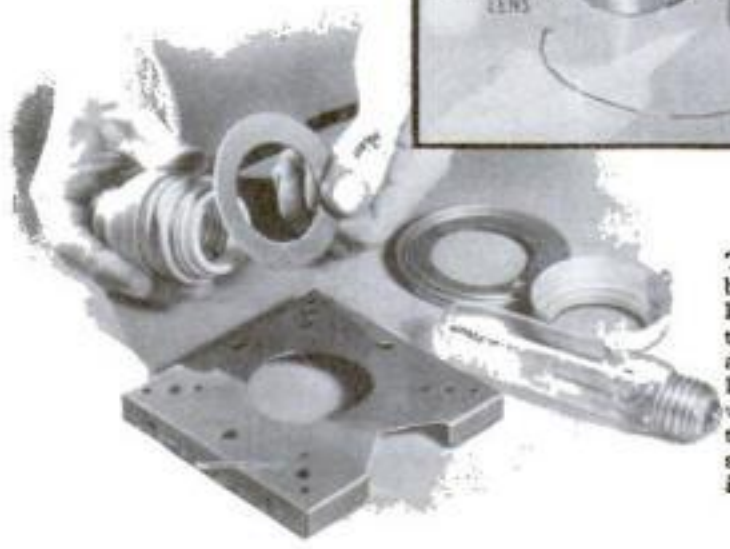
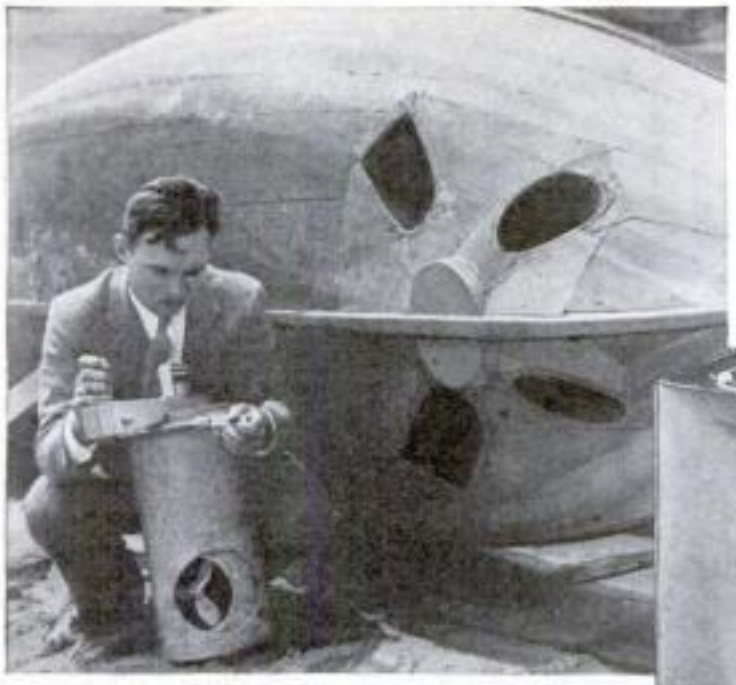


Diagram at left shows the manner of constructing a laboratory-type lamp at a fraction of the cost of a ready-made article. This gives you a light similar to that widely used in research laboratories

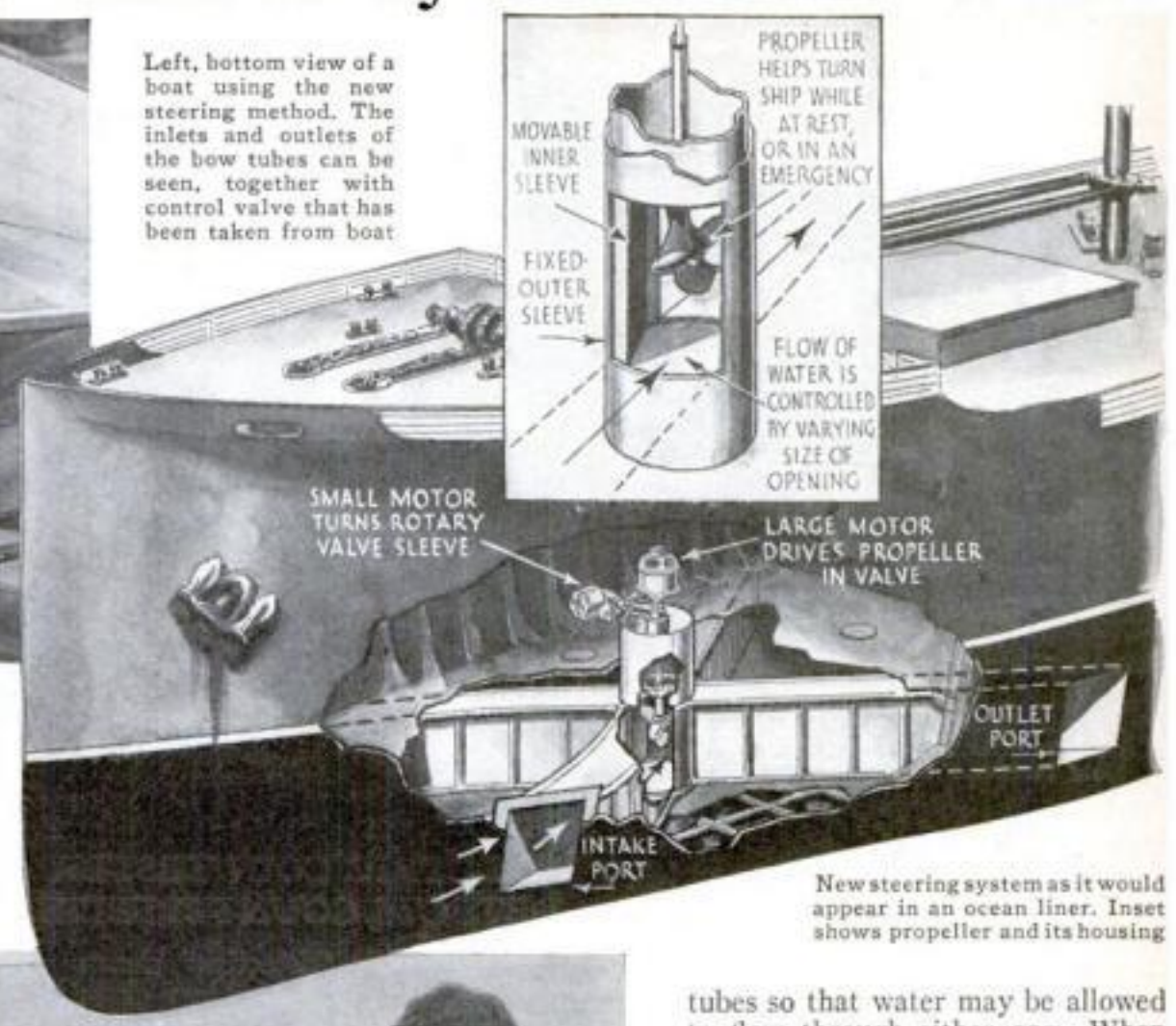


The best way of assembling the homemade illuminator is shown in the two illustrations above and at left. The lens is held by the wire spring shown in the foreground. The screw-on sunshade is in front of lens tube

Rudderless Ship Steered by Streams of Water



Left, bottom view of a boat using the new steering method. The inlets and outlets of the bow tubes can be seen, together with control valve that has been taken from boat



New steering system as it would appear in an ocean liner. Inset shows propeller and its housing

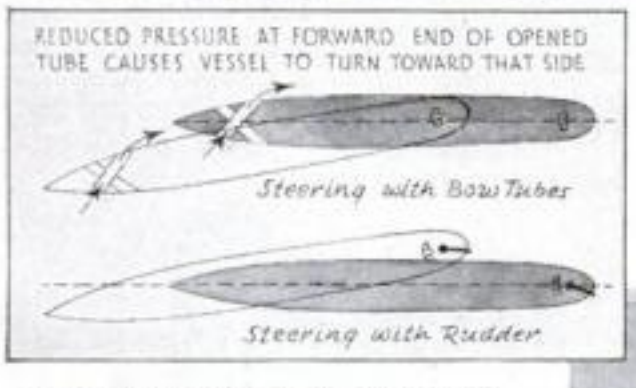
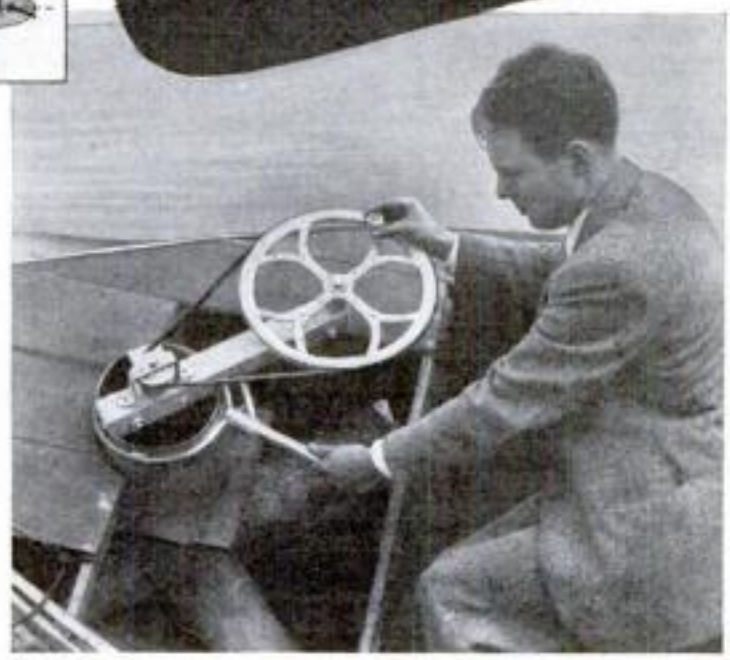
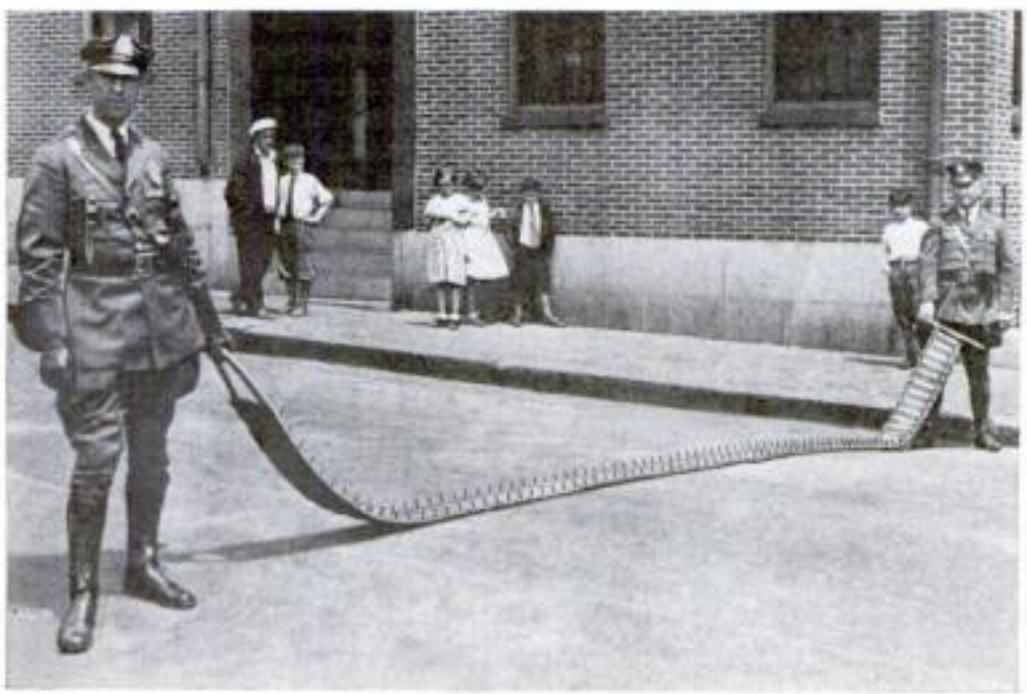


Illustration above shows old and new methods of steering a ship. Right, motorboat with bow-tube steering device



RUDDERLESS ocean vessels are envisioned by H. W. Falker, Middle Village, N. Y., inventor of a steering method that eliminates the frictional drag of a large rudder situated in the propeller wash. As a result, he maintains, the speed of a ship will be materially increased, and it can be operated with improved economy. Additional advantages claimed for the method he provides are that a ship can maneuver to or from a wharf without the aid of tugs, and while at sea can turn with unusual swiftness, if necessary, to avoid a collision. According to Falker, his plan operated successfully when tested on a small scale with the aid of a fourteen-foot outboard motorboat. It consists of installing two tubes in the bow of the boat, crossing each other diagonally, and open to the water at each end. A rotary valve is placed at the crossing of the tubes so that water may be allowed to flow through either one. When the boat is under way, it may be steered by opening one of the tubes, and the reduced water pressure at the forward end of the opened tube causes the boat to turn toward that side. A propeller, placed inside the valve and operated by hand, also permits the boat to be maneuvered in close quarters while at rest, and gives additional steering effect if desired, when under way. In a large craft the propeller would be operated by a powerful electric motor, and would be withdrawn from the valve chamber when not in use. The accompanying drawings give additional details of an installation of the new steering system, suitable for a typical ocean liner. It is believed that the new system would prove of special value in increasing the maneuverability of large vessels in close quarters.

SPIKE-STUDDED STREET CARPET TO STOP SPEEDING CARS

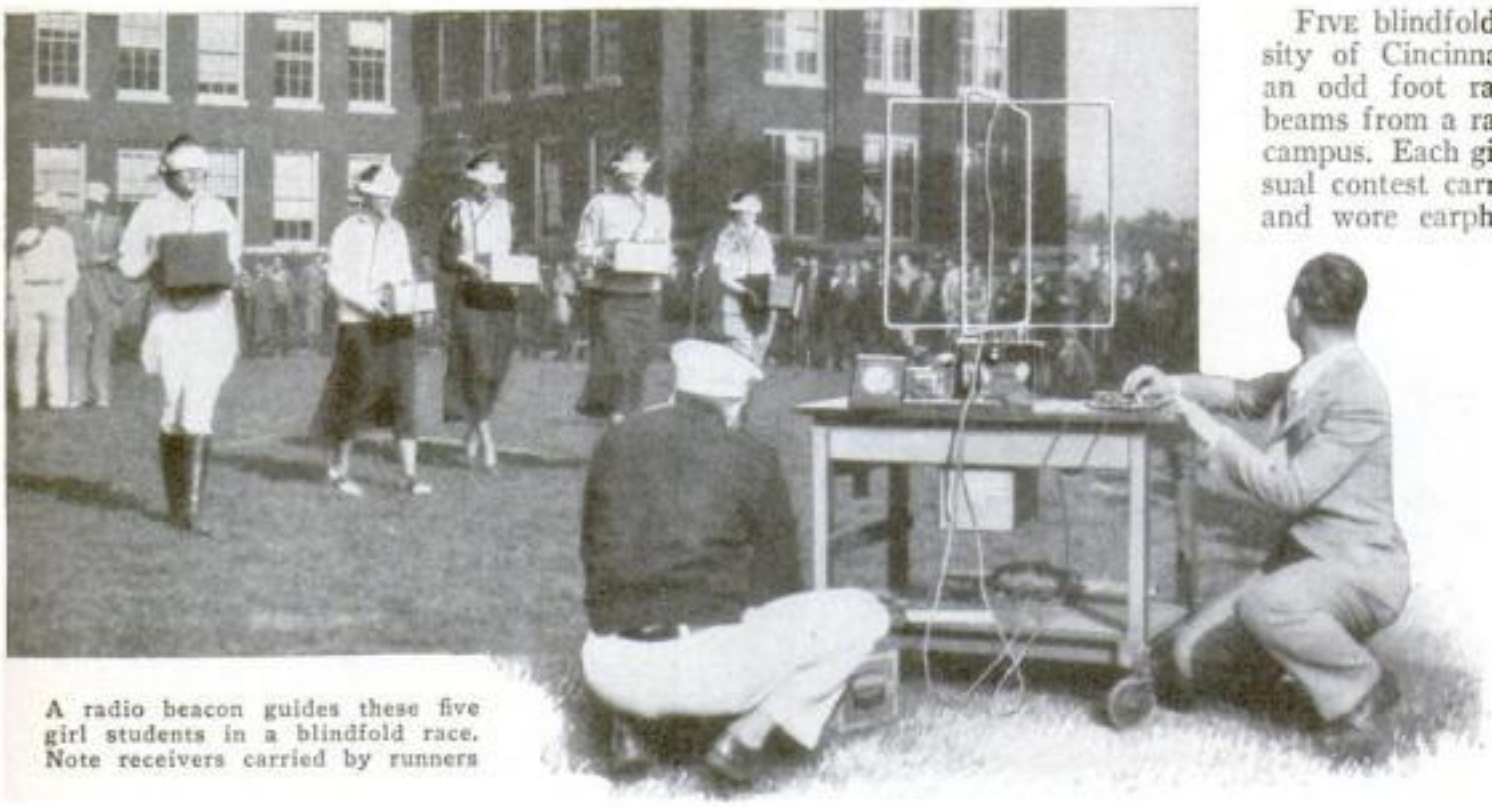


DIFFICULTY and danger encountered in stopping speeding automobiles have led Boston police to experiment with a speeder's carpet designed to puncture the tires of a fugitive car and thus halt it. The carpet is a strip of leather long enough to span the usual city street and containing two rows of long, sharp pikes that are held rigidly upright. On the approach of a speeding car, the strip is unrolled and stretched across the car's path. It is expected that the spikes will deflate all four tires of a car as it crosses the carpet.

OUR MECHANICAL WONDERLAND AGAIN AT THE WORLD'S FAIR

VISITORS to A Century of Progress exhibition at Chicago this year are again invited to inspect POPULAR SCIENCE MONTHLY'S Mechanical Wonderland. This exhibit shows, by means of more than 200 working models, the principles on which some of the most marvelous of modern machines operate.

Radio Beam Guides Girls in Blindfold Race



A radio beacon guides these five girl students in a blindfold race. Note receivers carried by runners

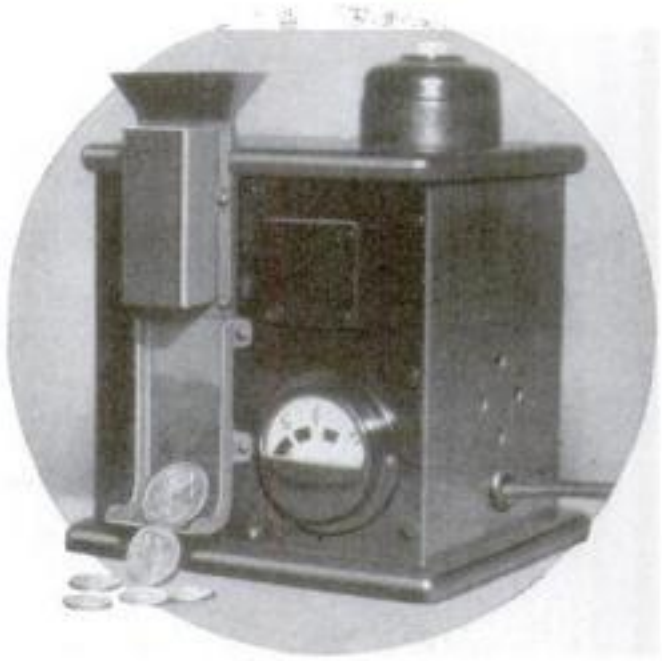
FIVE blindfolded co-eds at the University of Cincinnati recently competed in an odd foot race, guided only by the beams from a radio beacon set up on the campus. Each girl taking part in this unusual contest carried a small receiving set and wore earphones through which the guiding signals were heard. The signals transmitted were of two kinds like those used to guide planes on commercial airways, one indicating to the contestant that she was following the true course and the other telling her that she was wandering astray. The girls had little difficulty finding their way to the spot where the transmitting antenna had been temporarily set up.

HOUSE STUCK ON A WALL IS BUILDERS' NIGHTMARE

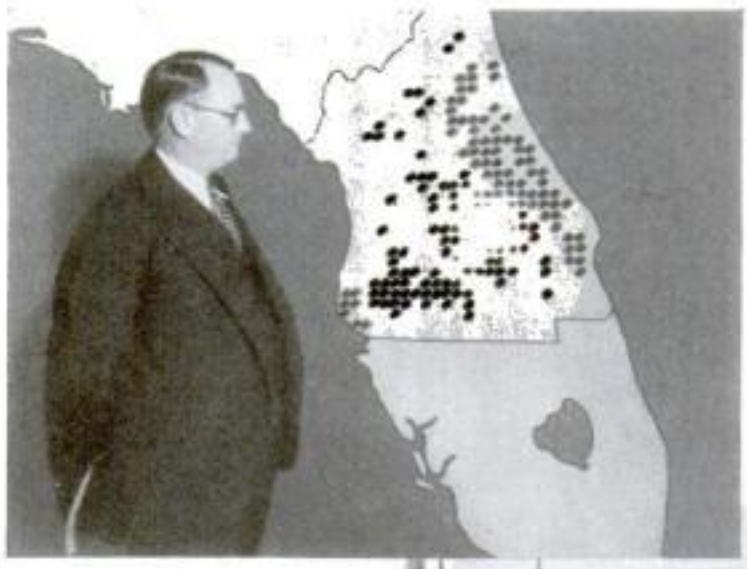
DEFYING all the laws of engineering, a house that is probably the most top-heavy structure in the world stands next to the gardens of King Fuad, at Mendora, Egypt, The house was built as the result of a dispute over the ownership of a plot of ground. One claimant, in an attempt to establish his title to the plot, reared a spite wall on it. The other hung a house upon the wall. The hanging house, ornamented in the Egyptian style, contains three narrow rooms. To reach the rooms it is necessary to use a ladder, as the ground floor is merely the thickness of the wall. This remarkable structure, believed to be the only one of its kind in the world, is shown in the photograph above.

ELECTRIC COIN TESTER DETECTS COUNTERFEITS

THE electric "detective" shown at the right is being used by a chain of banks in Australia to detect counterfeit coins. Invented by an Australian, the testing device is built into a box six inches square, and includes a slot for coins and a small dial. The latter bears three markings: sixpence, one shilling, and two shillings. Suspected coins of these denominations are dropped into the slot and a button on top of the device is pressed. If the coin is genuine, a needle swings around to the proper marking on the dial. If it is counterfeit, the pointer remains stationary at zero.



LIGHTS TELL STORY OF WAR ON PEST



Above, L. A. Strong, chief of the Bureau of Plant Quarantine, watches map portray conquest of fruit fly

TINY flashing lights, mounted on a large map of Florida, are telling World's Fair visitors of the victory won by the U. S. Department of Agriculture over the Mediterranean fruit fly in that state. Each of the 181 lights represents an area in which the pest appeared. The light flashes on to indicate the arrival of the fly in the area, and is extinguished to show its disappearance.

Right, the mechanism that controls the map. Revolving drums with contacts keep lights flashing in sequence

Spearing Balloons Is New Boat-Race Hazard

Spearing balloons at the end of a lap is a thrilling new feature of power-boat racing recently put into use by a racing association in California. Photo shows spearman poised for a lunge

BALLOON "busting" from careering speedboats is the spectacular sport recently devised by a racing association in California. Before the start of a race, a cable is stretched above the starting line of the course about ten feet above the water. Large toy balloons are suspended from the cable by means of weighted cords that are just long enough to enable the balloons to be touched by a mechanic standing in a speeding boat. As the pilots steer their craft under the balloons at the finish of each lap, the mechanic, armed with a spear and standing in the boat, attempts to puncture a balloon. If he fails, the pilot must circle about until the mechanic finally succeeds in spearing his balloon. Only then can the boat continue on with the next lap.

DIVING HELMETS WORN AS SWIMMERS LEARN STROKES

DIVING helmets are worn by pupils taking swimming lessons from a San Francisco, Calif., instructor who employs a radical new method of instruction. Wearing these helmets, the beginners frequently remain under water for long periods during which they study the swimming movements of the instructor and later attempt to imitate them. The helmets are made from thin metal containers and cost little. The bottom is removed and the sides hollowed out to fit over the shoulders. The helmet is held in place by straps that pass under the arms of the wearer. Good vision is insured by a large rectangular window in the front of the helmet and air is supplied by a hose that leads to an air-pump at the surface.

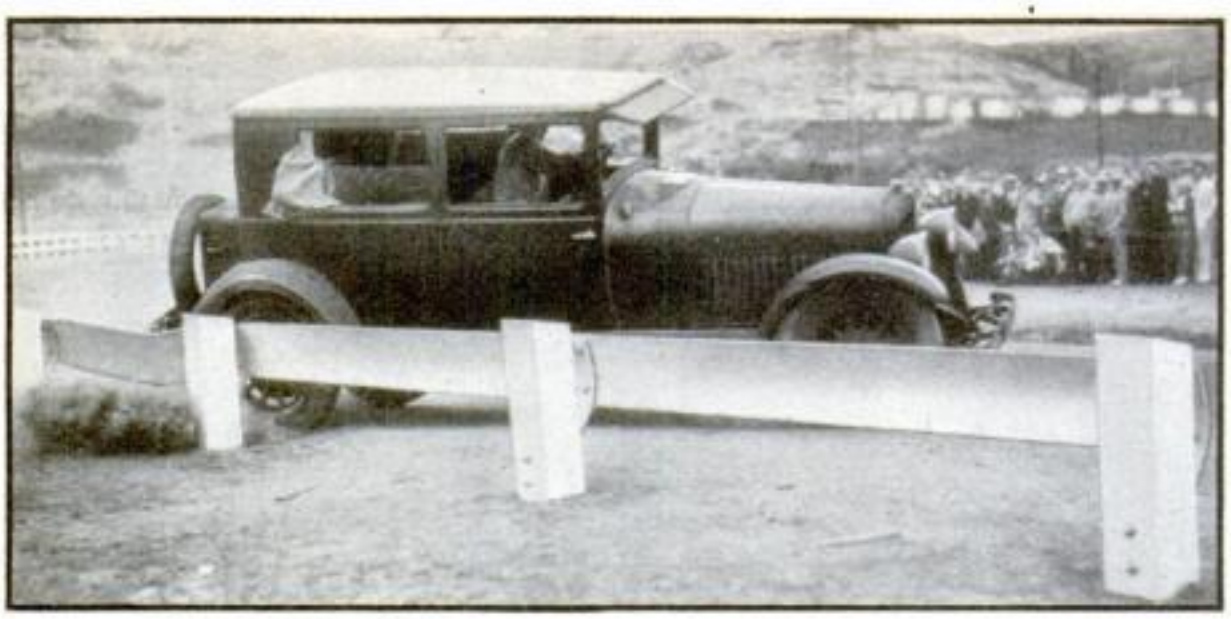
TICKET CHOPPER ENDS THEATER GRAFT

THEATERS are protected against fraud by an ingenious new ticket chopper that makes impossible the reselling of tickets. The new chopper guards the management of the theater by automatically sorting the ticket stubs according to the hour of deposit. Once an hour the hopper of the machine rotates and the stubs are deposited in a different container. At the same time, a bell rings in the box office and the cashier is required to note the serial number of the ticket being sold at that moment. Any ticket not deposited in the chopper within an hour is instantly identified when this number is compared with the serial numbers of the stubs in the different containers.

Left, general view of new ticket chopper designed to stop fraud. Above, device with hopper removed

TINY NEW BRAKE TESTER WORKED BY ONE HAND

ONE of the most compact brake testers yet devised can be operated with one hand. The new device weighs only a few pounds. The wheel whose brake is to be tested is jacked up and the brakes applied. The tester is then clamped to the tire. Downward pressure is applied to the handle of the tester, as shown at left, until the wheel is made to turn. The pressure causes a needle to move and the reading on the dial, as wheel starts to move, indicates the holding power of the brake.



DRIVER CRASHES CAR IN TEST OF GUARD RAILS

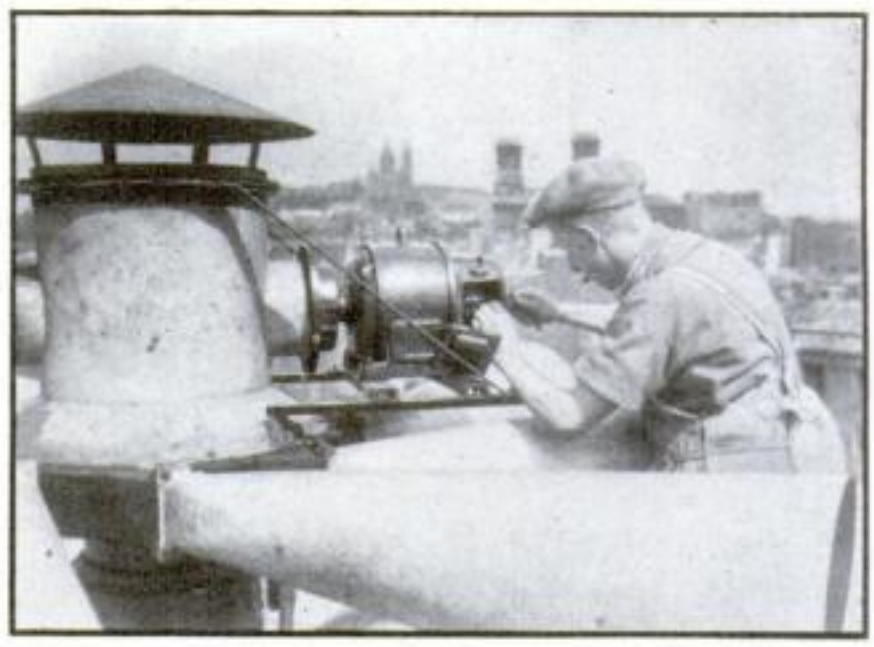
HAIR-RAISING methods were recently used by engineers on a California highway to test a new type of metal guard rail. Driving an automobile at high speed, the driver cut the front wheels sharply and threw the car into a skid. The rear end of the car crashed into the guard rail, as shown in the snapshot at left. The new guard rail is a wide strip of metal, held several inches in front of a line of heavy upright timbers by supporting metal arms. When the rail is struck, the metal arms bend, thus cushioning the shock and reducing the liability of the car crashing over into the ditch.

USE CARBON DIOXIDE IN NEW GLOW LAMP

LIGHT, practically the equivalent of daylight, is provided by a new-type tubular lamp that uses carbon dioxide instead of filaments. It provides illumination in much the same way as the neon and mercury-vapor lamps. The carbon-dioxide gas is made to glow by passing an electric current through it. The photograph above shows the new lamps undergoing tests.

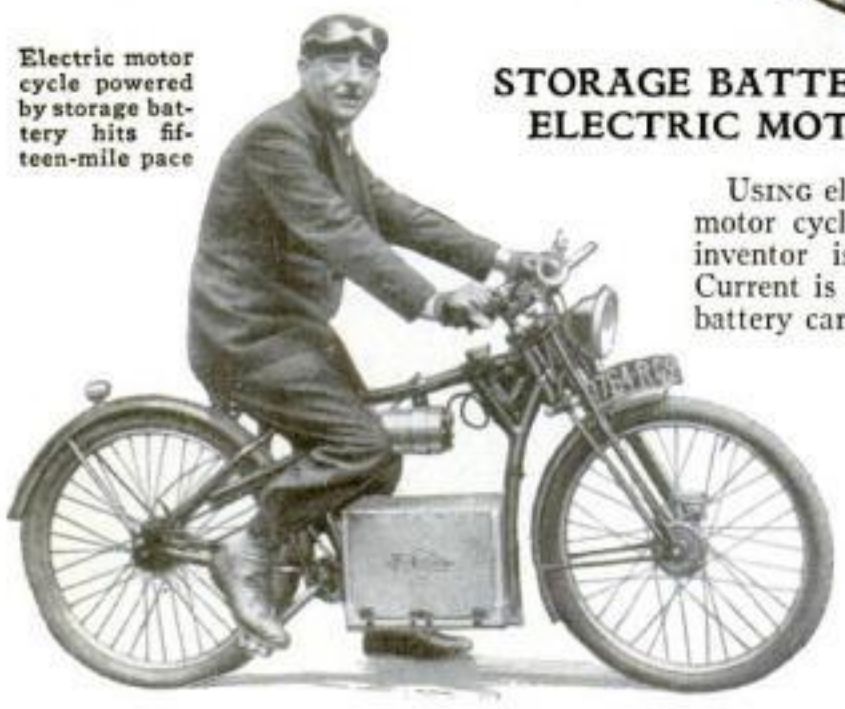
MOTOR-DRIVEN SIRENS WARN OF AIR RAID

MOTOR-DRIVEN sirens are being installed on the roofs of tall buildings in Paris to warn residents of the approach of raiding airplanes in the event of war. Each of the sirens, of which two have already been built, is provided with eight conical horns. The horns are arranged in a circle so that their alarm can be sounded in every direction. Special power plants supply current for the sirens.



BLACK LIGHT REVEALS INVISIBLE MURALS

MURALS, painted with invisible color, are the latest wonders achieved by applying science to art. Such invisible murals, now being applied to the walls of a room in the Benjamin Franklin Institute in Philadelphia, Pa., depict outstanding events in Franklin's life. In ordinary light, the walls bearing the murals appear as blank. Under ultra-violet rays, however, the murals appear in strong colors.



Electric motor cycle powered by storage battery hits fifteen-mile pace

STORAGE BATTERY POWERS ELECTRIC MOTOR CYCLE

USING electricity for power, a motor cycle built by a Parisian inventor is virtually noiseless. Current is supplied by a storage battery carried on the frame between the wheels, in the position occupied by the engine in gasoline cycles. The cycle can run more than forty miles on one charging of the battery and can maintain a speed of more than fifteen miles an hour.

GAS IN NEW SPRINKLER CHOKES FIRE

AUTOMATIC protection against fire is offered by a recently marketed, self-contained sprinkler that fights flames with a smothering gas. The aluminum sprinkler units are hung from the beams or ceilings of the rooms to be protected. When fire breaks out, the flames melt a solder cap to release the gas, which, being heavier than air, descends and smothers the fire.

By
EARL CHAPIN
MAY

America

FALLS IN STEP TO CALL OF

Drum *and* Bugle

THEIR members ranging in age from eight to sixteen, competing drum corps recently marched and played before critical judges in Philadelphia, Pa. These school children, led by tiny drum majors, professionally whirling their batons, demonstrated their proficiency and the popularity of the drum corps. For this Philadelphia contest was not unique. In thousands of other towns and cities, similar contests are held each year. Nor is this surprising in view of the fact that the drum corps is America's basic musical unit. It was important in Colonial times and as the fife and drum corps it flourished through the Revolutionary War, the War of 1812, the Civil War, and survives in the annual G. A. R. reunions.

The World War restored it to national popularity. Since then more than 20,000 organized and well-trained public-school bands and more than 30,000 high-school orchestras have been scientifically developed and continue to function. All of them, however, are founded on the drum corps, of which several thousands are now active in this country.

The drum corps is basic because nearly every boy and girl is born with a sense of rhythm. Our cavemen ancestors beat time on hollow logs. The Chinese have been beating time on calfskin drumheads for 30,000 years. Human hearts beat rhythmically; the earth rotates rhythmically; we breathe rhythmically; hence, we inherit rhythm.

Thus it happens that Charles Goodhall of Sedan, Kan., can assemble twenty-four girls from the Sedan public schools, where they have been taught the meaning and length of musical notes; can refresh their memories about full notes, half notes, quarter notes, eighths, sixteenths, thirty-seconds, sixty-fourths, and grace notes by diagrams on a blackboard; can instruct them in holding drumsticks and making rolls and in a few weeks turn out a group of skilled drummers. All of this, the result of lessons given twice weekly, with a maximum of forty-five minutes a lesson.

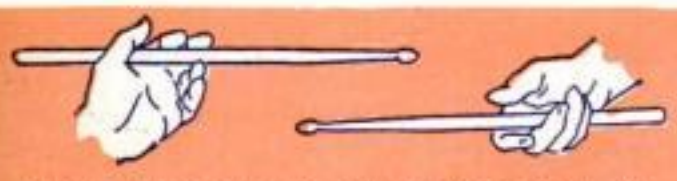
For the same reasons Professor O. H. Gerlat can begin at the School of Engineering, Marquette University, Milwaukee, Wisc., with an equipment of twenty snare drums, two bass drums, twenty ordinary or "soprano" bugles, four bass bugles and two bass

drums on December 1, and on the following March 17 can send his boys out for an exhibition drill and parade to celebrate St. Patrick's Day.

An example of how easy it is to start and develop a drum corps is found in the public schools of Springfield, Mo., where a high school chorus has been taught to sing "by rote." Applicants for the drum corps were lined up and marched around the school auditorium to piano music. Those who did not fall into step readily were eliminated. Final selections also were made by size, to secure uniformity in marching appearance.

Those finally selected were taught, by example, to hold the left drumstick between the thumb and first finger and the second and third finger; the other stick gently wrapped in four fingers of the right hand. Having readily achieved the first necessity of successful snare drumming, they began on a simple "mama-dada" roll—two strokes with the left hand for "mama" and two strokes with the right hand for "dada".

After this, the first of the classic fundamentals which have been indorsed and used by master drummers for more than two centuries in Europe and America, progress toward speed and variety can be made rapidly. But snare-drum sticks must be held in this manner if the drummer is to attain excellence and learn to drum tirelessly.



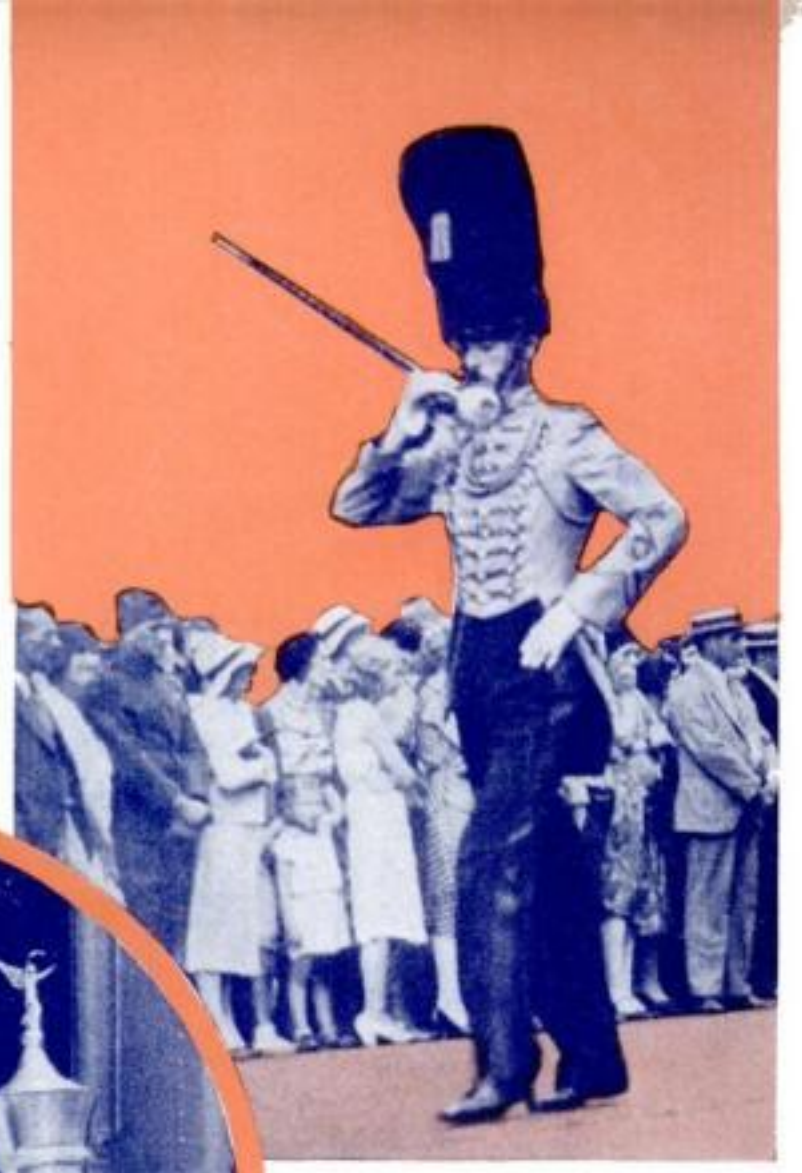
Correct method of holding drumsticks for street playing. Note the difference between right and left hands

The drawing at the left shows the open single tap as done slowly, at the right as done "closed" at a rapid speed. The player is using a practice pad for a drum

The familiar long roll, beginning, at left, with open beats, two to each hand. As the roll is "closed", the hands are brought closer to the pad, as at the right

Left, the high left-hand flam. The beat is alternated from hand to hand. In making the flam at faster tempo the hands come down close to the pad as shown at right

Lee Suttel, drum major of an American Legion Corps at Buffalo, N. Y., with a cup he won as the champion baton twirler of the Legion, in a contest at a convention



The famous Sanford A. "Gus" Moeller, teacher of many drumming stars and author of text books on drumming, once put on his Colonial drummer's uniform, hung his deep, army-style drum over his shoulder and, just because he had long wanted to enjoy a real march with a drum, walked and drummed his way from New York to Boston. He completed the trip of about 250 miles over the Boston Post Road in eleven days, marching every foot of the way and beating his drum at every step.

During nighttime stop-overs, he gave drumming exhibitions before American Legion Corps and before other corps belonging to the New England Drum and Fifers' Association. By carrying his drum and holding his sticks in the traditional rudimental manner, Gus made the journey without raising one blister on his hands.

James M. Spencer, who joined the Union Army in 1861 as a fourteen-year-old drummer with Company H of the Fifty-Seventh Indiana Volunteers, drummed through the Civil War; "tapped," "sticked," and "rolled" with the 158th Regiment Indiana Volunteers through the Spanish-American War, and with the Home Militia of Sheridan, Ind., during the World War. He continued drumming at all patriotic gatherings until he was well along in his eighties. Drummer Jim Spencer carried a deep-bodied army style drum. A shallow drum has not enough "body" for marching.

James Whitcomb Riley drummed with the Greenfield, Ind., boys from 1868 to 1878, which may explain why he was so adept at writing rhythmic poetry.

Arthur "Dad" Rackett, who has been beating the "side drum," or snare drum, since 1874 and still does the long roll or "Mama-Dada"; marching tap beats, with or without "flams" or grace notes; "ruffs", strokes and "drags," "ratamacues", "paradiddles" and all the other tricks with drum sticks that experts can do, is probably the oldest active rudimental drummer, for he is still on the job at the Wisconsin Veterans' Home. Dad volunteered for the World War and became the white-haired drummer in the 1918 version of "The Spirit of '76."

Dad is the son of a drummer. So is George Lawrence Stone of Boston. In fact, Stone is the fourth generation in a family that has drummed professionally. Hence, it is not surprising that he should be the drum instructor of Marlboro, Mass., Drum and Bugle Corps which started in 1930, made its first important public appearance at the American Legion national convention at Boston that year.

Snappy Military Units Provide a Treat for Eye and Ear as New Fad Sweeps the Country

This snappy corps, representing a Baltimore, Md., Legion post at a convention in Kansas City, presents a fine appearance on parade

and became the Legion's national champion drum corps during the Chicago convention and contest of 1933.

Nearly 250 Legion drum and bugle corps were in the annual parade at the Chicago convention. Almost every State in the Union was represented. A majority of the corps entered the annual contest. Hence, when Marlboro became the national champion it had to show something in playing and drilling. The Marlboro corps was typical of the Legion in that only two of its players were professionals, a proportion that will hold good for most of its 2,000 or more drum corps.

Stone is, of course, a "rudimentalist" and not a "catch as catch can" or "scratch" drummer. To reach the prize-winning class in any of the local, county, state, regional, and national corps contests held from the Atlantic to the Pacific each month in the year snare drummers must be trained in the rudiments.

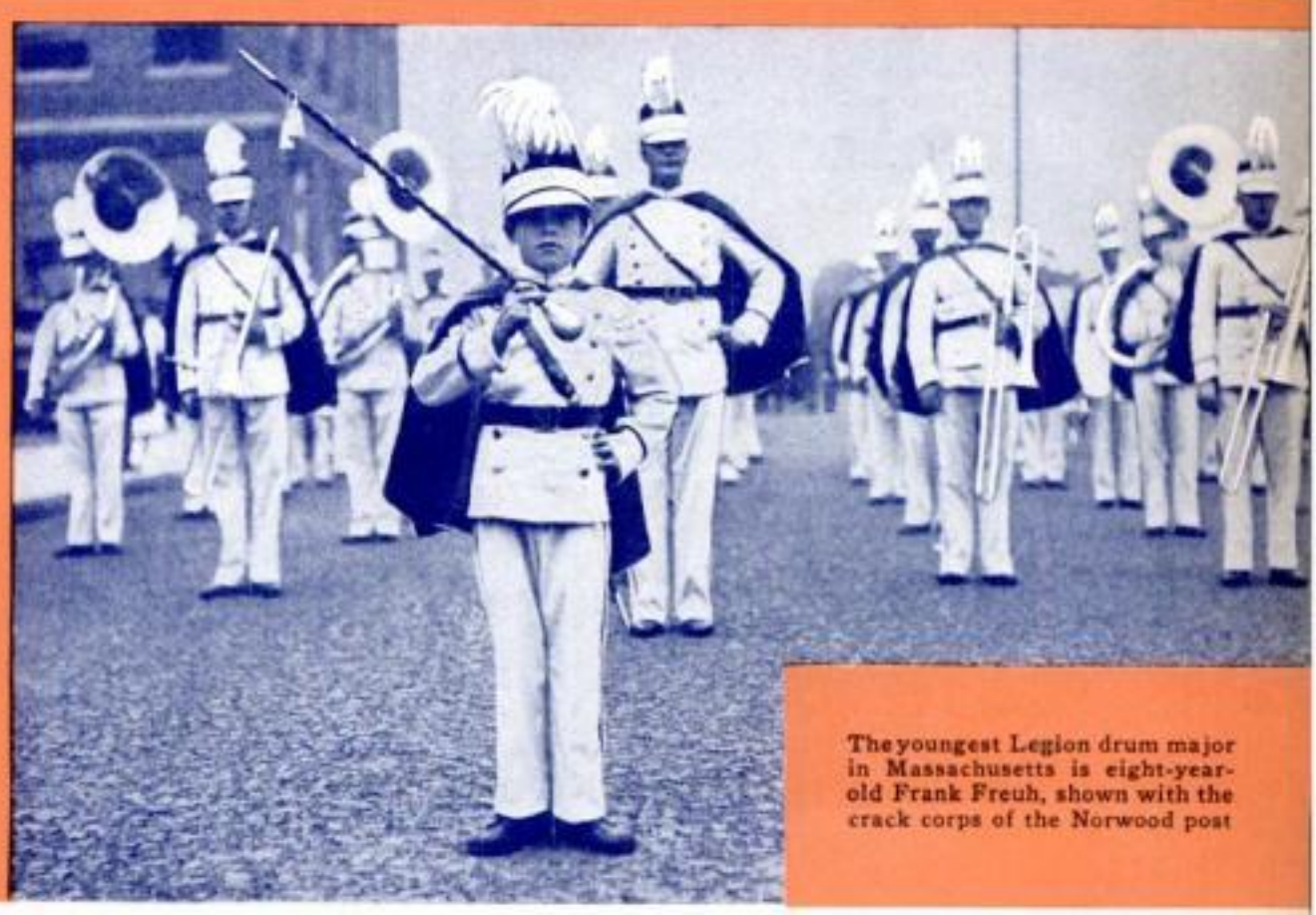
In order to make this training as painless for the public as possible, pupils are taught, not on resounding drumheads, but on little rubber practice pads. From practice pads, the pupils go to drums. Under proper instruction it does not take long to teach a group of normally intelligent men to play the drum and bugle. The North Chicago Post of the American Legion ordered corps instruments and obtained an instructor in February, played creditably on the local Memorial-Day and Fourth-of-July parades the same year, and during that September won fourth place against thirty contestants in the Illinois State Drum Corps Contest.

The buglers had a tougher time of it. Buglers must not only have a sense of time or rhythm, they must also have a sense of pitch or tonal altitude. must be able to tell a high tone from a low tone by ear. Tone is the result of vibration, the faster the vibrations the higher the tones. Tones, properly associated, make a melody. Also, tones, properly superimposed, make harmony. But the first problem in bugling is to make some kind of a tone.

The old army or regulation bugle has no keys or valves and yields "open tones" only—C, G and E, for the Reveille and other bugle calls heard so often in army camps.

A good teacher shows his pupil, by example, that his lips must act like rubber bands and be laid loosely against the bugle's cup-shaped metal mouthpiece: cheeks drawn in rather than protruded; the tone attacked by a quick stroke of the tongue between the lips which must not be too close together. Only a little breath is required for such tone making. The higher tones are made by drawing the lips tighter, the lower tones by loosening the lips. Under no conditions must the mouthpiece be pressed against the sensitive lip muscles.

By using this non-pressure system, sore lips are avoided and a bugler can play almost forever without being tired or without playing blue notes. In my youth we blunderingly played high notes by



The youngest Legion drum major in Massachusetts is eight-year-old Frank Freuh, shown with the crack corps of the Norwood post

A prize-winning American Legion drum and bugle corps about to go into action in a national competition. Military bearing and striking uniforms are important to success

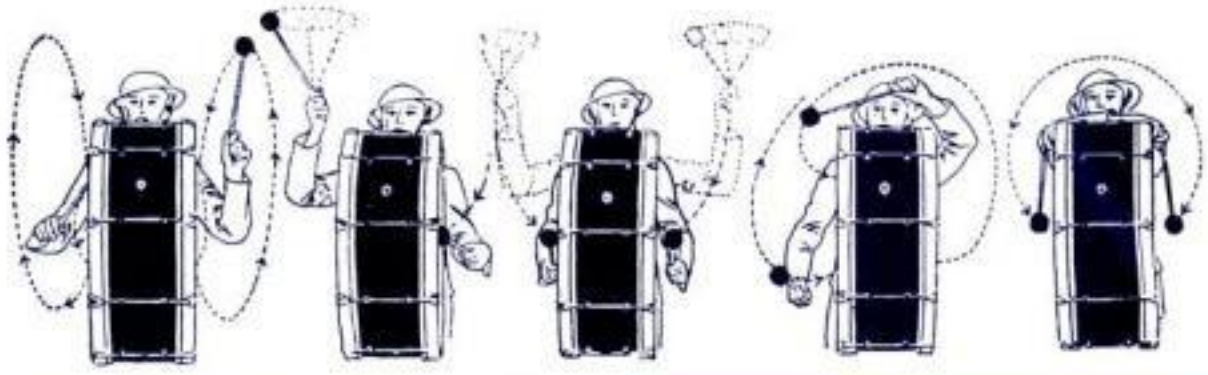
punching the mouthpieces against our lips. The lips were therefore crushed against the teeth. As a result, the buglers' lips either became leather or were as sore as boils and were useless after an hour or so of playing. With the modern, non-pressure system, good tone is always possible and the bugler, like the rudimental drummer, can go on forever. A five-hour march does not faze him.

Nearly all beginning buglers naturally sound the note "G" on the staff. Tests with a blackboard and a teacher's bugle soon teach the young pupils to pick out the C and E on the staff. Later they learn to reach the G and C above the staff and to find the C below the staff. A few hours of this fundamental teaching and the buglers are started on tunes.

John Philip Sousa was one of the pioneers in showing the possibilities of drums and "open tone" bugles. In 1888 he wrote a Trumpet and Drum book which included not only the rudiments of drumming but also a march for drums and bugles which he entitled, 'With Steady Step." A few years later the March King wrote part of "With Steady Step" into the trio or last movement of his famous "Semper Fidelis," first played by the celebrated Washington Marines Drum and Bugle Corps.

The recently introduced piston bugle has changed the tonal picture for adult as well as juvenile corps. Open-tone bugles are usually in the key of G and only G, C, and E, with their octaves can be sounded. A piston, or single-valve bugle, adds four tones to the standard or open-tone instrument. Also, baritone or bass bugles are built with longer tubing, which makes their tones an octave lower than the standard instruments, thus giving body to the music.

That is why your surprised ears have been hearing in recent parades of drum and bugle corps "Susan Jane," "The Cavalier," "America," "Onward Christian Soldiers," "These Are My Happy Days," "Auld Lang Syne," "The Long, Long Trail," "Who's Afraid Of The Big, Bad Wolf?" and a dozen other old and new favorites which were formerly played only by bands.



Doing the Scotch Twirl on the bass drum

Enlargement of scope in bugle playing, plus increase in the numbers of rudimental players have encouraged the organization of so many drum and bugle corps that thousands of youngsters and adults are marching forward toward national harmony, toward a creative use of leisure.

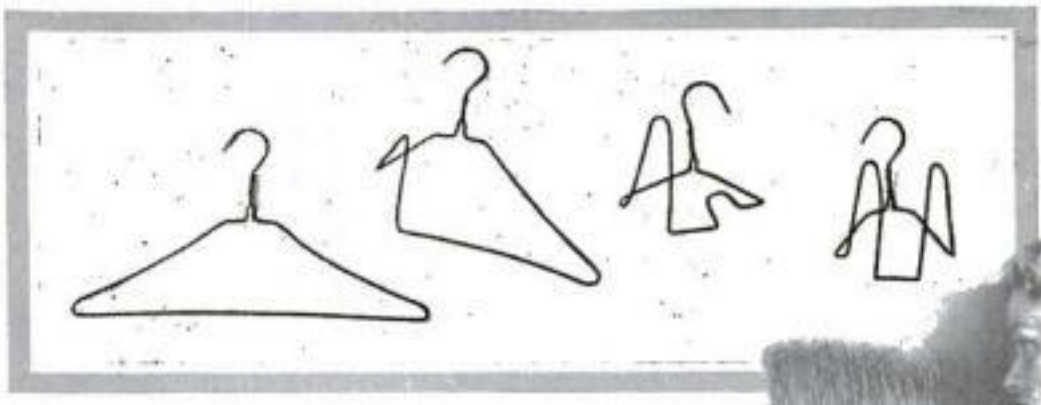
As an example of how quickly the rhythm and harmony idea takes hold there is the little town of Chelmsford, Mass., not far from Boston. Last Christmas Guy E. Hazeltine proposed a junior drum and bugle corps for his American Legion Post at Chelmsford. His Post promptly made him chairman of a Drum Corps Committee which sent out a circular letter explaining to parents, public-school teachers, and other adult citizens why a Junior Corps would be beneficial.

The Legion offered to buy the equipment. The public bought most of it by attending card parties, concerts and other benefits. Instructors were secured at a modest figure. George McElroy, who made "Dot" Slamin the national junior champion drum major, voluntarily took the Chelmsford junior drum majors in tow. Soon the Chelmsford Juniors became a civic institution.

Thus are the older musicians preparing for the time when they can no longer thump and bugle; thus are good Americans carrying on a tradition going back to Colonial days; thus are we living in a new era of rhythm and harmony, for we have never had so many drum and bugle corps as we have today.

George Lawrence Stone, veteran teacher and a descendant of a drummer in the Revolutionary War, shows how to hold sticks for rudimentals

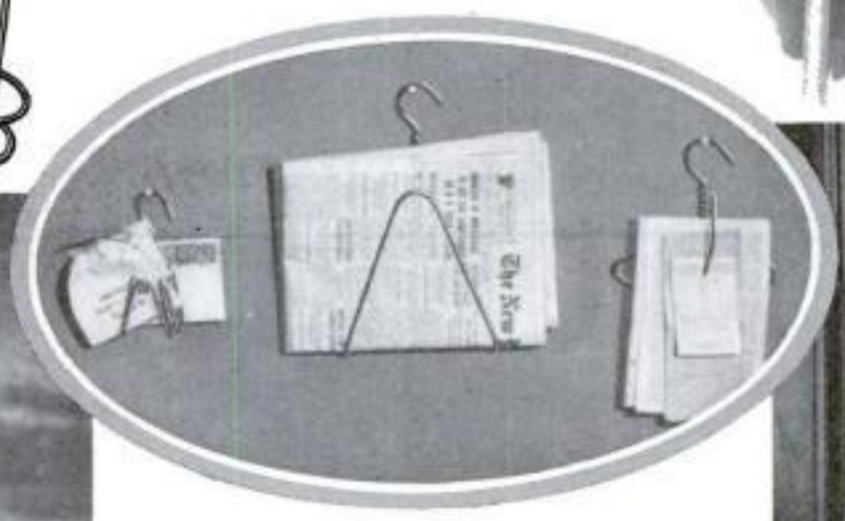
Useful Articles Made from Coat Hangers



BROOM HOLDER. The photo at left indicates successive stages in the making of a broom holder. Below, using holder

PLIERS, a file, and a pile of wire coat hangers are the only equipment and materials required for making a variety of wire articles useful in the home. For purposes in which rustproof qualities are important, gadgets can be constructed from galvanized hangers. Those made of heavy wire are preferable for any article in which rigidity is desired, and those of lighter stock for things with complicated bends. Your ingenuity may find many other uses for coat hangers besides those pictured here—hooks and hangers of all kinds, croquet wickets, flower-bed fences, and so on.

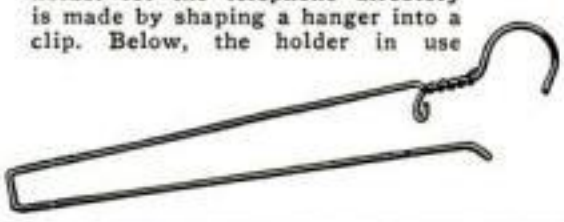
FLOWERPOT HOLDER
Made easily from a garment hanger, this holder supports a plant on a wall or pillar. Right, how the wire is shaped in loops



A GROUP OF USEFUL GADGETS. A letter file, newspaper rack, and bill hook, all made of old wire hangers, are shown in this picture. A little imagination will suggest many other uses

CAMP TOASTING FORK. A galvanized hanger is used, the wires being crossed near the prongs. Leave some spring in handle to make the fork rigid

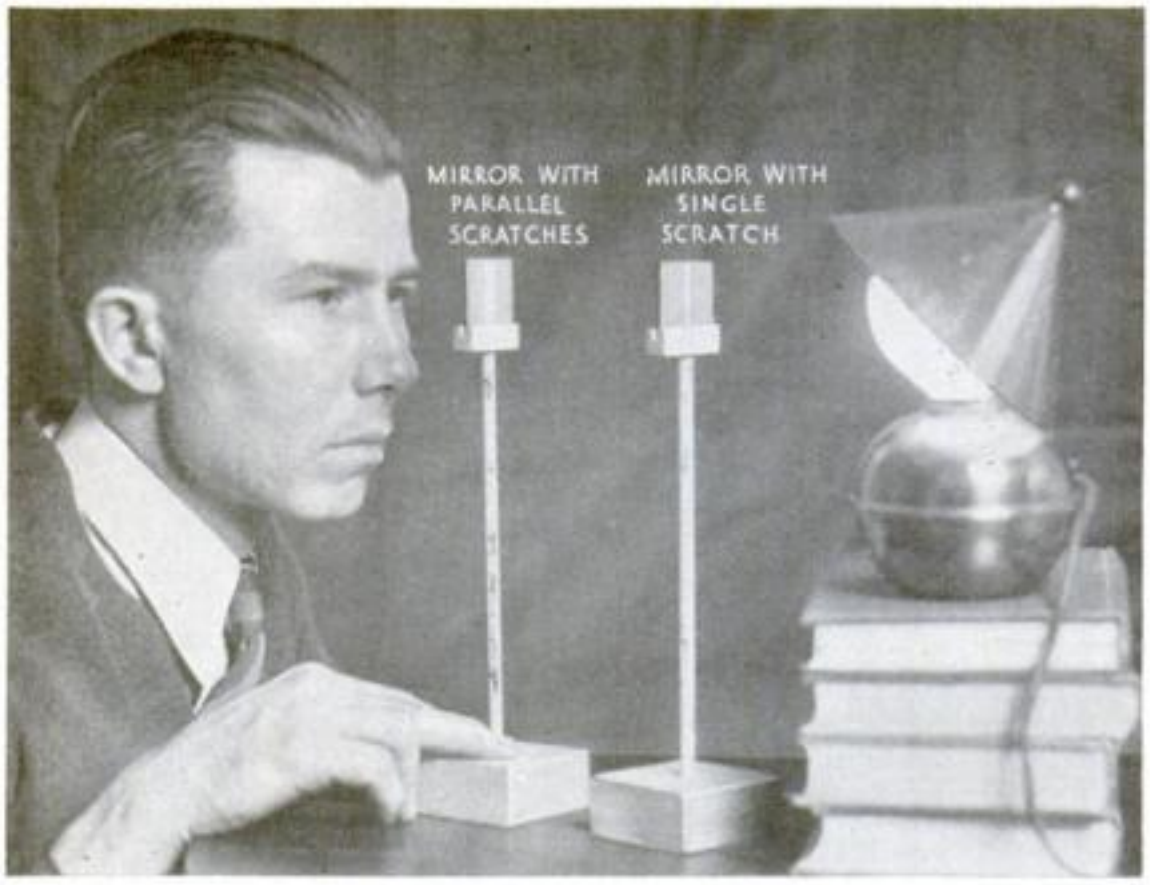
CLIP HOLDS PHONE BOOK. A holder for the telephone directory is made by shaping a hanger into a clip. Below, the holder in use

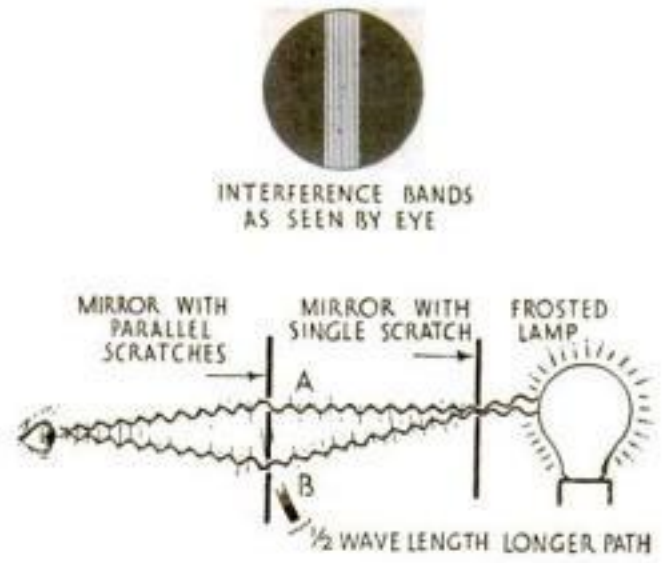


STRETCHER FOR WOOL HOSE
Mark a point three inches from the center of a galvanized hanger as the center of the toe of the stretcher, and the sides will work out in the shape of a foot for the drier

TIE RACK. Bent as shown here, a hanger makes a tie rack. The two horizontal arms are held together by a rubber band in the center, forming a clip

TIE PRESS. Creases disappear from neckties when they are stretched on this tapered press. The press also serves as a hanger for the necktie





INTERFERENCE BANDS IN LIGHT

With two mirrors, one with a single straight scratch and the other with two parallel scratches, arranged in front of a light bulb, as at left, interference bands can be seen when the light coming through the single scratch is viewed through the two scratches. The interference bands will appear as in the circle at top. The diagram above shows how the waves in the light rays meet out of step and cause the fine lines

Scratched Lines on Mirrors Show

How Astronomers Measure Enormous Stars

ONE of the most fascinating surprises you get in reading about the development of modern science is the way in which some apparently trifling discovery, made by a pioneer, gives the key to the most amazing and unexpected results many years later. For instance, Michael Faraday's toy electric generator, made from a few turns of wire, wound with rags for insulation, became, a hundred years later, an enormous dynamo, supplying a whole city with light and power.

In a previous article we recalled how Newton's discovery that a prism splits sunlight into colors, which can then be re-combined into white light by another prism, became the spectroscope, revealing the chemical composition of the most remote suns in the universe. (P.S.M. June, '34, p. 47).

In the same way a simple phenomenon, first observed about 1801 by Thomas Young, an English physician, has in our time given us a yardstick with which to measure the sizes of these same stupendous suns. The most remarkable thing about the yardstick is that it is only about 1/50,000 of an inch long!

It requires little apparatus to remake Thomas Young's discovery that light waves "interfere." Two bits of mirror and a sharp knife or compass point for scratching lines across them are all you need in addition to a frosted electric bulb.

In the illustration at the top of this page, Young's experiment, the bits of mirror are mounted on light wooden standards, but the same results are obtainable with the mirrors held in the fingers.

The mirror nearer the lamp has a vertical line scratched through the silver backing. The mirror nearer the eye has two straight vertical lines, ruled as close together as possible.

When the lamp light coming through the single slit is viewed by your eye through the double slit, you will notice that the image of the single slit is apparently ruled with several very fine, hair-like lines.

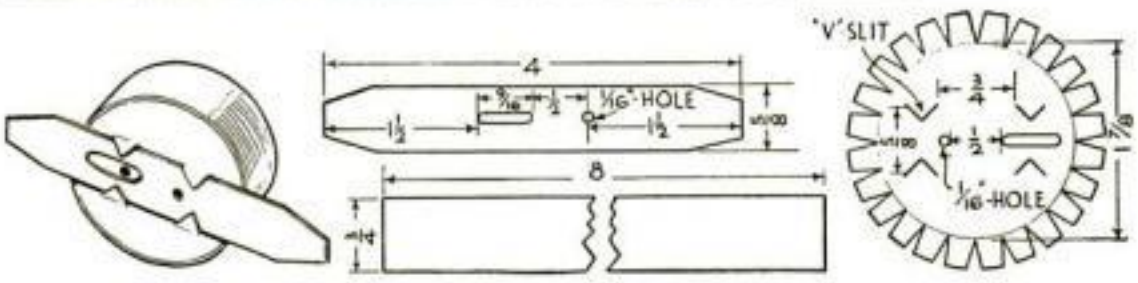
The diagram at the right of the picture explains what causes these narrow stripes. It shows two rays of light from the lamp bulb passing together through the single slit. Each ray is oscillating transversely, in waves, as indicated in the diagram.

HOW TO MAKE INTERFERENCE LIGHT LINES DISAPPEAR

A mirror with a single vertical scratch, is set up in front of a light, as below. Two mirrors, one with a horizontal scratch and one with two converging vertical scratches, are placed together and the light coming through the first mirror is viewed as shown in the illustration. As one mirror moves over the other, the interference lines disappear and only a clear white image of the vertical slit will be seen by the observer

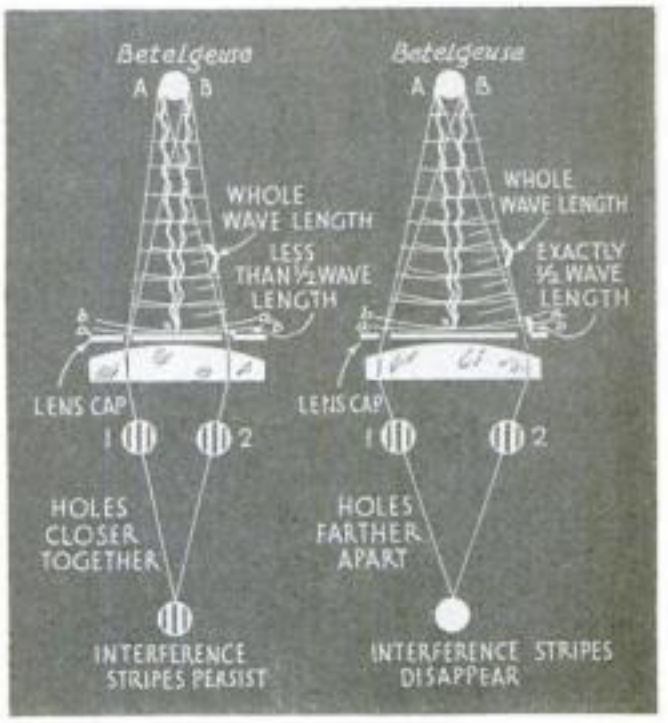
Simple Apparatus You Can Make for Yourself Gives Clear Idea of How Gigantic Dimensions of Suns Were Determined at Great Observatories

By GAYLORD JOHNSON



HOW TO USE INTERFEROMETER TO DETERMINE SIZE OF STARS

Photograph at top shows how the principle of light interference is used to find the size of distant stars. The apparatus needed, in addition to a telescope, is given in the diagram above. The distance between the two holes in the cardboard cap is varied until the interference lines disappear. Calculation will then give you the linear width of the slit in the black paper which is set up before a light. In measuring stars, the slit in the paper is replaced by a star as Betelgeuse at right, and its size is found exactly as you found the width of the slit in the black paper



Ray (A), let us say, travels straight to the eye through one of the two slits in the other mirror. But ray (B), diverging at a slight angle from (A), must travel a slightly longer distance in reaching its slit than (A) does.

The concentric arcs of circles, drawn through the wave crests and troughs, show that ray (B) travels half a wave length longer, and arrives at its slit with its wave motion just opposite to (A's). What will happen? The trough of wave (B) will interfere with and neutralize the crest of wave (A). Accordingly, a dark stripe will appear on the retina of the observing eye. In the same way other pairs of light waves, meeting in opposite phases, kill each other and a series of black outs result.

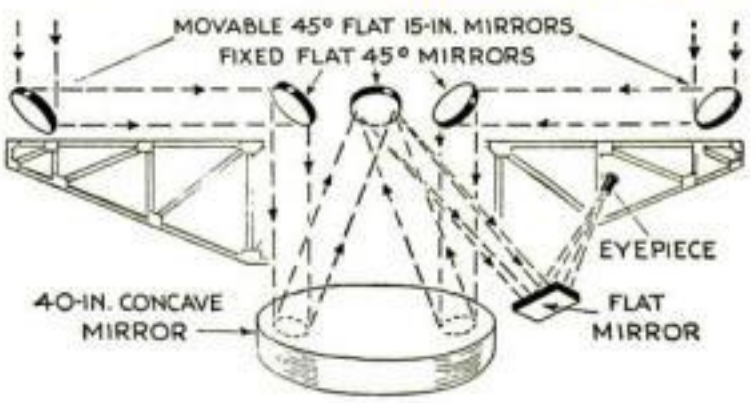
These areas of interference account for the dark hairlike stripes your eye sees.

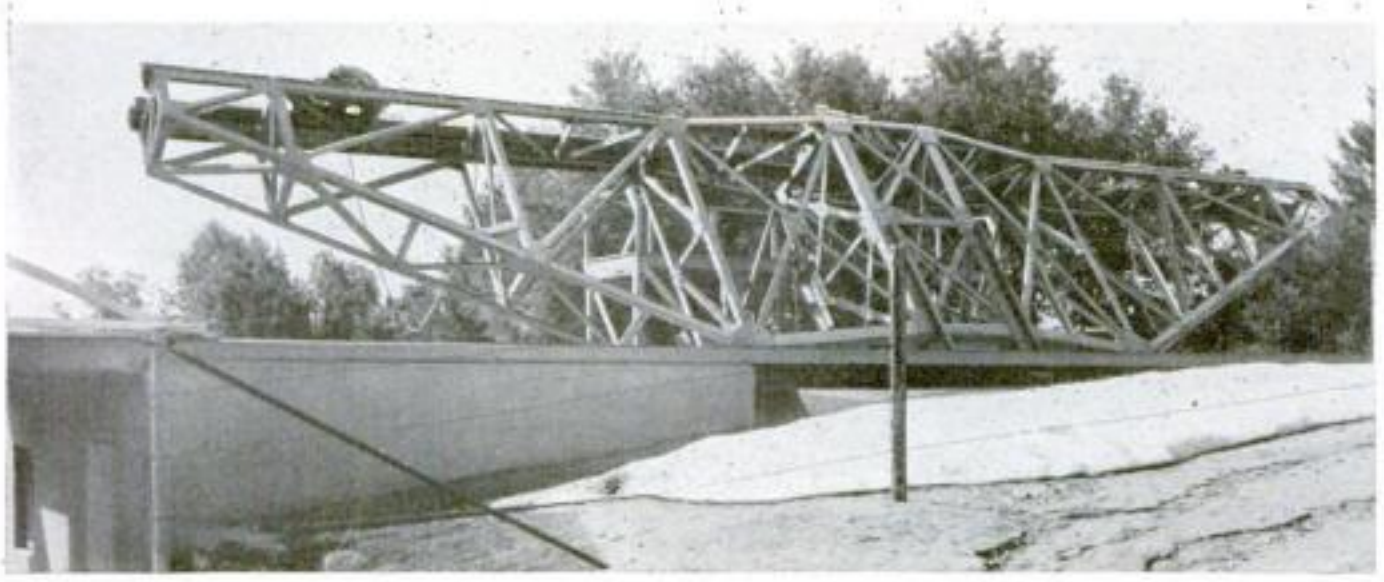
But in the case of the bright stripes, rays from other points on the lamp meet in the same phase of their wave motion and reinforce each other.

This was the way Thomas Young explained his discovery—the interference of light—but of course he could not foresee that the tiny distance of a half wave length of interfering light would be used by posterity as a yardstick for measuring the diameters of almost inconceivably large suns.

To see how this is done we must first try an interesting little experiment. Two additional bits of mirror are used. On one bit a single line is scratched across. On the other piece of mirror, two scratches are ruled so that they converge from an eighth of an inch apart until they meet. To try the experiment, hold the mirrors with their silvered surfaces in contact and slide one mirror over the other, with the single line at right angles to the converging lines on the second mirror.

As you slide the mirrors (meanwhile looking toward an electric bulb) you will see that two bright dots are formed where the single line on one mirror crosses the two converging lines on the other. These two bright dots approach and recede from each other as the mirrors slide upon each other in the vertical direction of the converging lines. After noting this, you are ready to try the experiment on which star measure- *(Continued on page 116)*





INTERFEROMETER MEASURES STARS

At left, the skeletonlike apparatus is the fifty-foot interferometer at Mt. Wilson Observatory. With this instrument, used as indicated in the experiment given at the top of this page, scientists have succeeded in measuring many gigantic stars, whose size is enormously greater than our sun. Above, illustration showing how the interferometer will give the fractional degrees of a sun's arc making possible the calculation of its exact diameter

Fortune in "Drowned" Logs

A FORTUNE in sunken timber is being recovered from an abandoned sawmill pond by a Wisconsin lumberman who designed his own apparatus for the purpose. The logs are found by dragging the bottom with a two-foot iron rod suspended from a swiveling, raft-borne hoist as shown at the left. It is equipped with a heavy sliding ring hammer and with a chuck that holds a large spike. After a log has been found, the sliding hammer is pulled up manually and released. The falling hammer drives the spike into the log. The log is then hoisted to the surface as shown below. A gas-powered winch is used.

DRY FUEL USED IN CIGAR LIGHTER

A POCKET cigar lighter that requires no liquid fuel is a recent innovation. Modernizing an old principle, it employs flint and steel to throw sparks against a tubular cartridge of inflammable woolly material. The dry fuel burns without flame, but with a glow that permits lighting a smoke in the strongest wind.

PADS PLUG EXPANSION JOINTS IN CONCRETE

CONCRETE bridge railings, roads, and sidewalks are protected from frost damage by a new sponge-rubber sandwich recently developed for use in expansion joints. These open joints are necessary to enable the concrete to expand and contract in varying temperatures. In winter, however, water that freezes in the joints frequently causes the slabs to buckle; in summer, foreign matter becomes clogged in the joints and prevents the slabs from expanding. The rubber prevents this.

MAP LIBRARY IS PLANNED

A GREAT map library, comprising more than 400,000 sheet maps, is being planned for the University of Chicago. Fifty thousand maps are now on file at the university. The chief collections of maps are at present owned by the government and are located at Washington, D. C. The Military Intelligence Division of the Army has a collection of 1,000,000 maps. Other large collections of maps are: The Library of Congress, 688,000; the Engineer's Office of the War Department, 260,000; the Interstate Commerce Commission, 175,000, and the United States Geological Survey, 87,000.

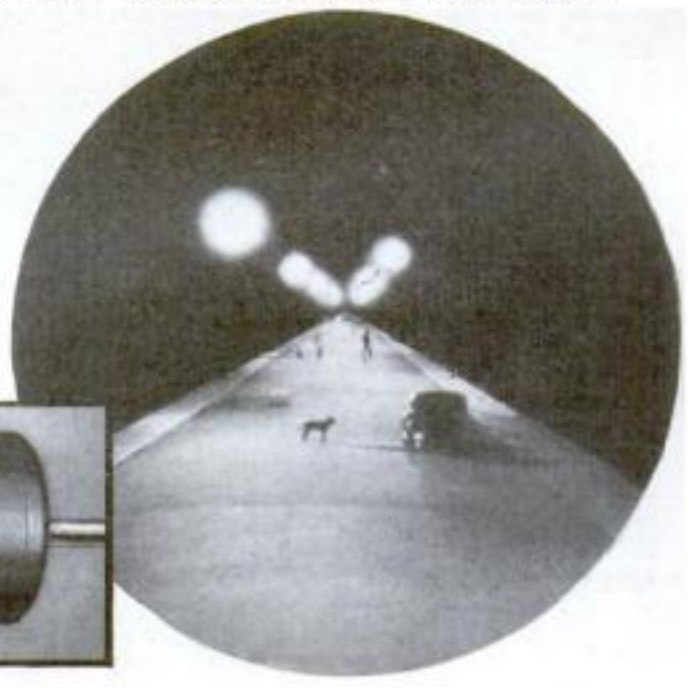
REMOTE CONTROL LOCKS CASH DRAWER

Hidden foot button locks cash drawer so it cannot be opened without special key. Inset shows drawer

DESIGNED to be proof against holdups, a remote-control cash drawer has been introduced. When a bandit appears, the storekeeper has only to press a concealed foot button to lock the drawer electrically. It cannot then be opened until a key is brought from a distant place and used in combination with the regular key. The drawer is made of heavy steel plate and is securely bolted to the counter so that it cannot be pried open or carried away. Another innovation is a money locker equipped with a delayed timing control that opens it just fifteen minutes after the combination is set. There is no way to hasten the action. Signs conspicuously posted warn bandits a hold-up would be useless.

USE MODEL ROAD IN LIGHTING TESTS

A MODEL highway, 240 feet long, has been built in the General Electric laboratories at Cleveland to test the efficiency of various methods of highway lighting. It represents a road thirty feet wide and nearly 2,000 feet long. Models of automobiles, pedestrians, and animals are employed to determine the visibility of objects under the various lights being tested.



Manuel King's pet dog, Trixie, is an important member of his troupe. She not only takes part in the act, but also protects her master

Eleven-year-old Boy is Lion Tamer

AN ELEVEN-YEAR-OLD Texas boy is making good at a job so dangerous that only the hardiest men attempt it. He is a lion tamer, probably the youngest in the world. Armed with a cracking whip, a light chair, and blank cartridge pistol, he strides fearlessly into a cage crowded with ten young lions and, at a sharp command, makes them roll barrels across the floor, frolic on a see-saw and roar lustily in mock rage.

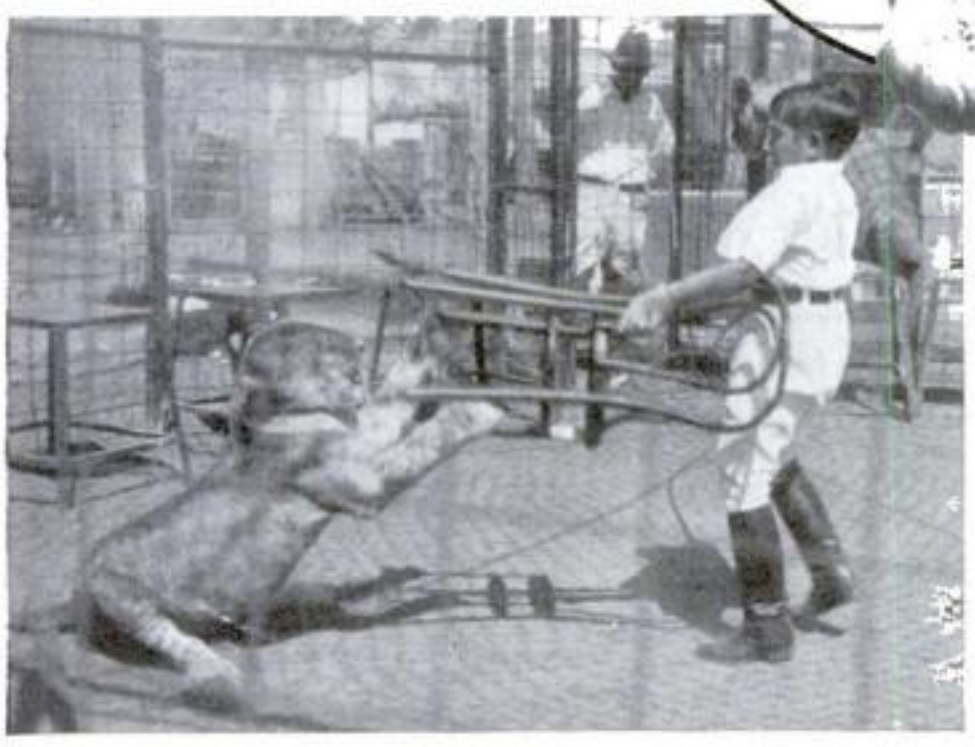
The boy is Manuel King, son of a veteran trainer who breeds lions, tigers, jaguars, and other savage animals in an extensive preserve along the Rio Grande near Brownsville, Texas. As soon as Manuel could walk, he was given lion and bear cubs to play with, but it was not until a year ago, when his father gave him ten new-born lion cubs for his birthday, that he became ambitious to be a lion tamer.

Confident of Manuel's ability, the father placed him in charge of John C. Guilfoyle, a trainer of thirty years' experience who trains the animals raised on the ranch. Manuel quickly became an apt and eager pupil, yet he presented a strange problem. He was so utterly unafraid of the lions that Guilfoyle had difficulty convincing him that precautions were necessary. He would turn his back on the beasts or hug them, actions which experienced trainers consider suicidal. At last Guilfoyle had to get into a mixup with the lions himself, letting them floor and maul him, to convince Manuel he was training treacherous killers and not playful pets.

Manuel's acts now resemble professional exhibitions to be seen at the circus. Not quite four feet tall, he seems a midget beside the roaring lions, but they obey him. When they grow balky, he cracks the whip over them. When one tries to approach him, he thrusts out the light chair, feet first. When, on rare occasions, this fails to stop the lion he fires his pistol.

Few veteran lion tamers would dare to do what the boy is doing in this picture. He shows no fear

Dynamite, a star barrel-roller of the troupe, sometimes refuses to perform. The picture above shows him in one of his tantrums



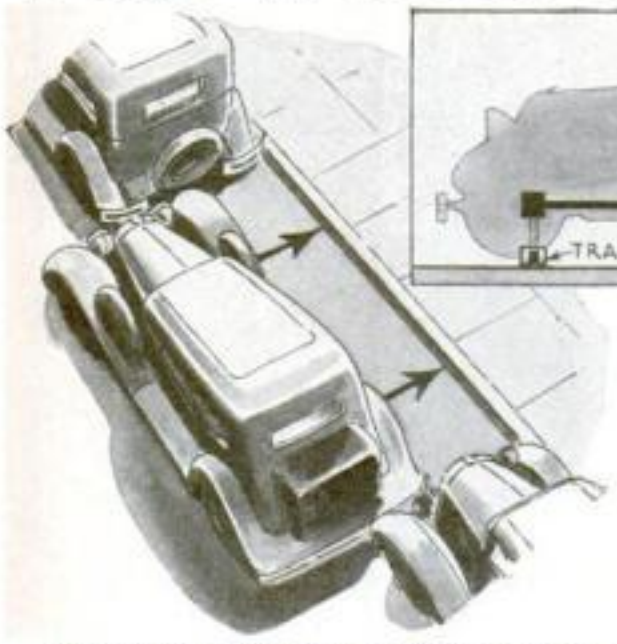
Yo-Yo, one of the boy's most trusted beasts, puts on a make-believe fight as a final thrill. The real crises of the act are often unseen by the spectators

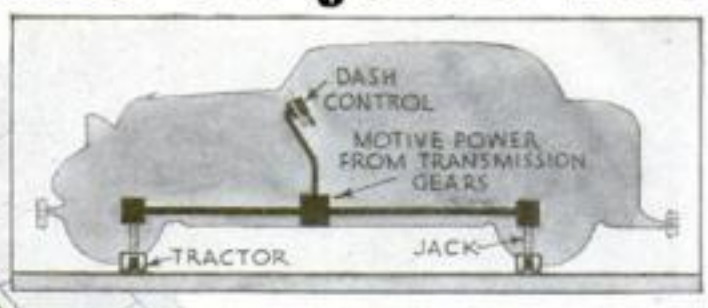
Manuel has trained one lion, named Yo-Yo, to furnish a thrilling climax to his exhibition. At a word from him, Yo-Yo roars terrifically, bares his dangerous-looking fangs and strikes out menacingly with his paws.

The only ally taken by Manuel into the cage, is Trixie, a sheep dog, born at the same time as the cubs and raised with them. If the lions become quarrelsome, Trixie jumps between them. A sharp bite on their sensitive noses sends them scurrying back to their places.

Except for his precociousness as an animal trainer, Manuel is a typical American boy. He is in the fifth grade at a grammar school in Brownsville and is rated above the average in his studies. He plays baseball with his classmates.

Four Wheels on Jacks Park Car





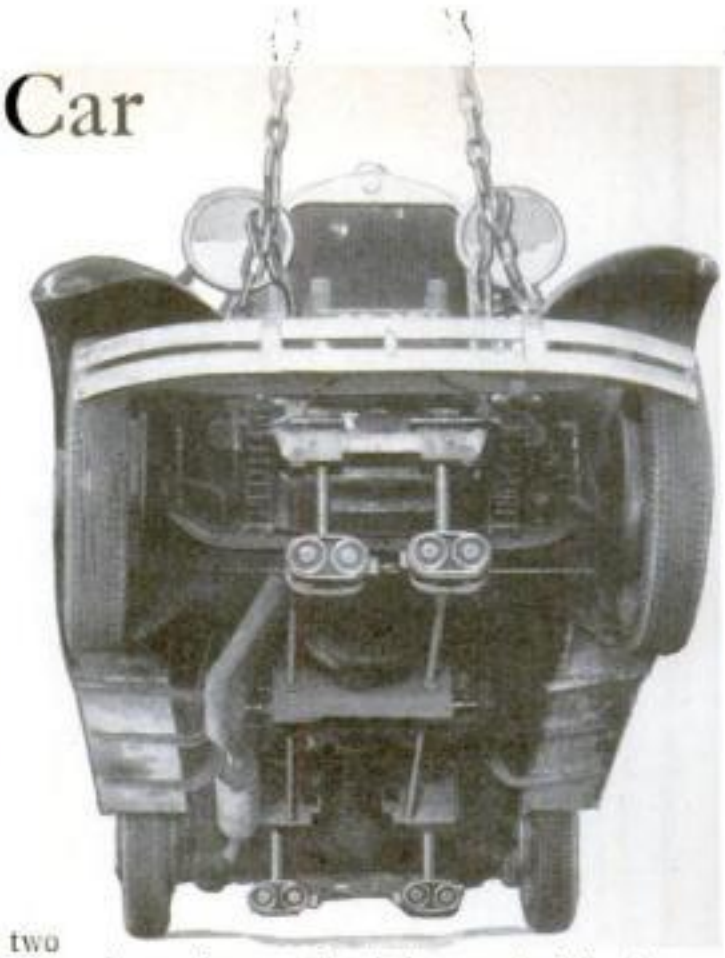
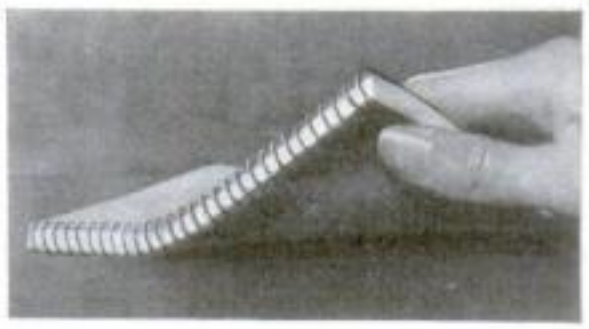


Illustration at top shows mechanism that parks car as indicated at left. Above, parking controls on dashboard. Right, car raised to give view of the device

PARKING is said to be made easy by a new device that lifts an automobile from its wheels and rolls it sideways into a restricted space at the curb. The actual parking is done by four power-driven jacks, two behind the front axle and two at the rear of the car. These jacks, terminating in small wheels running on endless tracks, are lowered by pressing a button on a dashboard panel. When the car has reached the desired height, one of two other buttons is pressed to move the car either to right or left. Power for these movements is taken by special gears from the regular transmission system. A fourth button on the dash panel is pressed to lower the car after it has reached its place at the curb. The device cannot be used until a parking brake is set and it is therefore impossible to lower the jacks with the car in motion.

BATHERS COAST DOWN DUNES

COASTING on sand dunes is the latest diversion to capture the fancy of thrill seekers at the seashore. The only equipment needed is a huge frying pan of the type used in hotel kitchens. The coaster carries this pan to the top of a hard-packed dune and gets in. A good shove sends him flying down the dune. The sport is particularly popular at Virginia Beach, Va., where it first appeared.

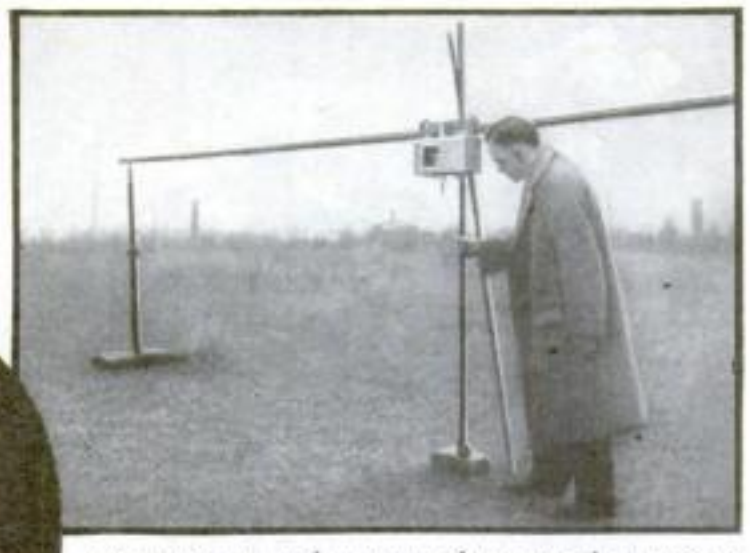


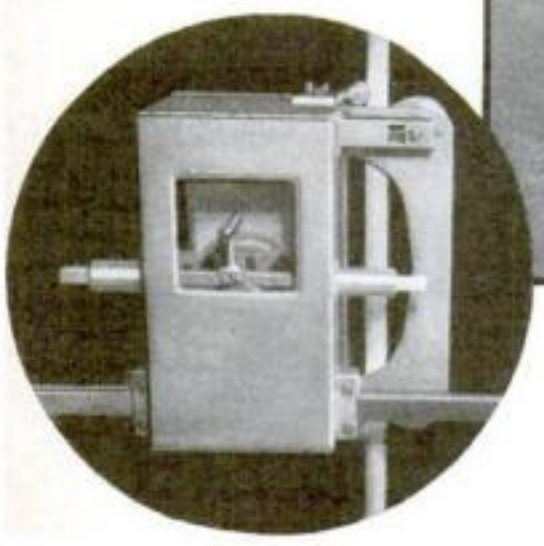
USE COIL SPRING TO BIND NEW MEMORANDUM BOOK

COIL springs form flexible bindings for a new type of memorandum books. One edge of the covers and pages of the book are perforated with more than twenty holes and the coil spring is threaded through these holes to make a permanent binding, as shown above.

AUTOMATIC PEN TRACES LAND'S CONTOUR

SURVEYING the contour of land is simplified by a newly devised instrument that writes an automatic record of the survey. As the device rolls along a level overhead track, a recording pen traces the contours to scale on graph paper that rotates on a drum. The pen is moved up and down on the paper by a long rod that reaches to the ground and glides over the surface on a roller attached to its lower end. Rotation of the drum is controlled by the movement of the device along the overhead track.





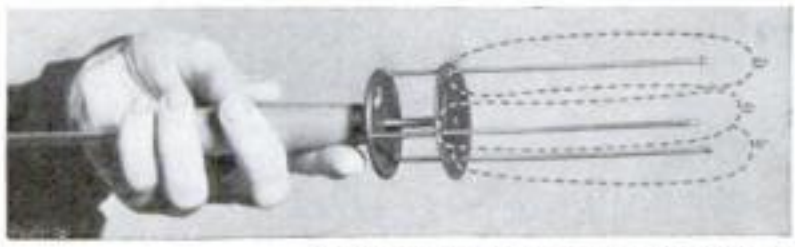
PISTOL-GRIP CAMERA WORKED BY ONE HAND

A MINIATURE aerial camera, recently developed in England, enables an aviator, flying alone, to take photographs with one hand while operating controls with the other. The camera has a pistol grip and its shutter is worked by trigger action.

Hunt Lost Gold in Big Diving Bell

WITH a new conical diving bell of huge dimensions, a daring Dutch salvage crew will soon make a second attempt to recover the $10,000,000 in gold that was carried to the bottom of the North Sea 200 years ago by the foundering British frigate *Lutine*. An attempt made last year to recover the treasure was abruptly halted when the bell being used in the work was wrecked by an explosion. Investigation showed that one of the mines planted in the North Sea during the World War had drifted into it (P.S.M., Jan. '34, p. 30). The *Lutine* is now covered by forty feet of sand. When salvage operations are begun, workers in the submerged bell will clear away the accumulation of sand, allowing the bell to descend gradually until the remains of the treasure-bearing vessel are encountered. Compressed air will be forced into the bell from a surface boat to protect workmen engaged in the salvaging operation from seepage of either sea water or sand. The task of recovering the sunken gold is expected to occupy several months.

ROASTER COOKS STEAK OVER OPEN FIRE



STEAKS can be cooked conveniently over an open fire by means of a new hand-operated roaster. The device consists of a yard-long piece of thick wire with a crank attached to one end and three wire prongs at the other. Its wooden handle is grasped in one hand and the steak is rotated as the crank is turned.

MAKE OLD BATTLE FLAGS LOOK NEW

Right, girls at work restoring an old battle flag. The remnants are pieced together and carefully sewed with silk so much of the original beauty is again apparent. Below, one of the flags that has been thus fully repaired

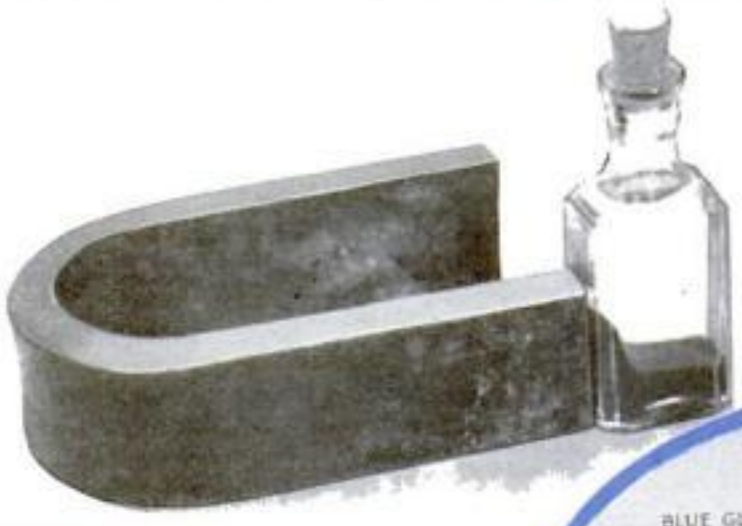
TATTERED battle flags are restored to a semblance of their original beauty by the astonishing skill and patience of French needle workers. Upon a frame similar to that used in making embroideries, girls lay out the shreds of shell-torn flags and carefully assemble them in their proper positions. The pieces are then bound with silk thread. The color of the silk matches that of the particular section of the flag on which it is used. Even when large sections have been lost, the remnants are so carefully matched that the flags look complete when the work is finished.

COLORED VAPOR REVEALS HOLES IN INNER TUBE

LEAKS in inner tubes that cannot be found by ordinary means are detected by means of a recently marketed device that indicates visually the position of the puncture. A gallon container, filled with a red liquid, is attached to a compressed air line or tire pump and also to the tube to be tested. Air, passing through the container under pressure, vaporizes the liquid as it is forced into the tube. The vaporized liquid then forces its way through the hole and leaves a red spot on the tube. In some cases, soapstone is so thick on the inside of the tube that the colored vapor will not readily penetrate it. Kneading the tube between the hands while inflated will break down the coating and permit the passage of the vapor. The colored liquid used in the process does not injure the rubber.

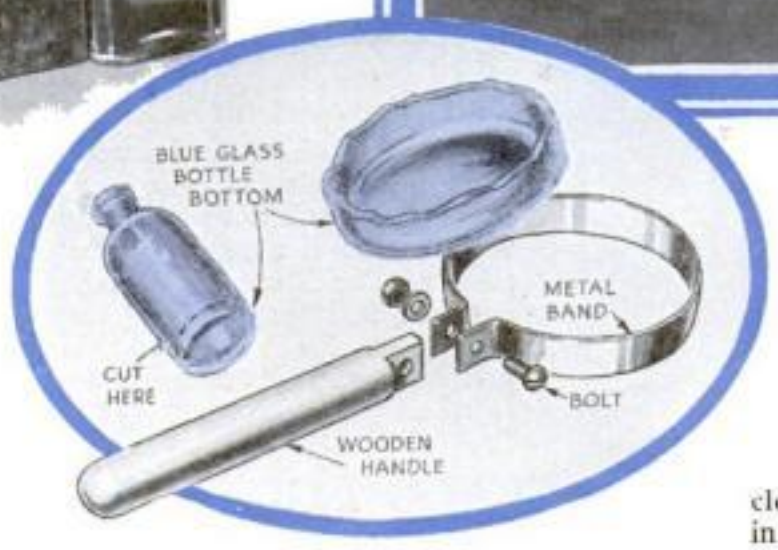
Colored vapor is forced into a leaking inner tube by the device seen below. Issuing from the holes, it leaves a red stain

Feats of MAGIC *FOR THE* Home Chemist



TEST FOR MAGNETISM

By exposing a quantity of iron hydroxide to a pole of a permanent magnet, you can prove its surprising magnetic quality. In this it resembles cobalt and nickel, which are also magnetic



SIMPLE FLAME FILTER

The bottom cut from an ordinary blue glass bottle makes a flame filter for testing unknown chemicals, as shown above. Diagram at left illustrates mounting of the glass in a convenient handle

HOW TO MAKE A BLUE SNOW

Cobalt hydromercurithiocyanateaffords a striking chemical "stunt". It can be precipitated from a solution by adding cobalt nitrate, and settles in the form of delicate flakes like a blue snowfall

STRANGE strips of paper that change color, and mysterious inks that disappear, are only two of the many novel tricks that can be performed by the home chemist who experiments with cobalt and nickel.

Both chemicals are highly colored, but the fact that cobalt compounds change color when mixed with water, opens the way to an interesting branch of chemical magic. In the first experiment, the amateur chemist will need several narrow strips of soft white paper and a simple solution of cobalt chloride, prepared by dissolving a few cobalt-chloride crystals. Immerse the paper strips in the solution and, when they are thoroughly saturated, hang them up to dry. In time, a peculiar effect will be noticed. In moist air, the strips will be unmistakably pink while in dry air they will be blue.

Perhaps you have seen paper or cloth prepared in this way and sold as a weather indicator. Often, it is made up as an attractive dress for a doll or folded to represent an imitation rose. That such devices will foretell the weather is erroneous, but they will, as we shall see, indicate humidity, which, of course, has a close connection with changes in weather.

By preparing two test containers, one having a dry and the other a moist, atmosphere, you can demonstrate this queer action of cobalt-chloride paper without waiting for the natural humidity of the air to cause the change. Two mayonnaise jars having screw tops can be used as the test chambers if they are supplied with test tubes or small vials to hold the test papers.

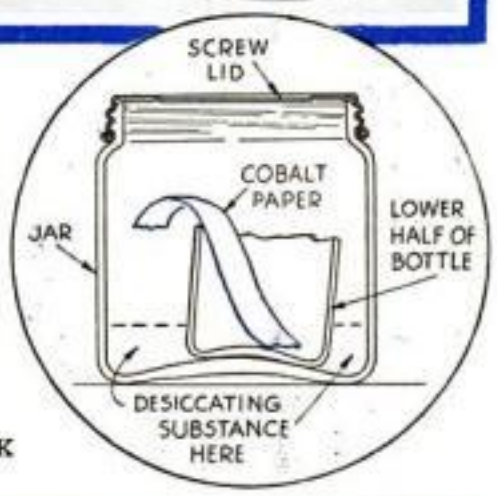
In the first jar place a few lumps of calcium chloride, slide the cobalt-chloride paper into the test tube, and screw the lid tightly in place. Since the calcium chloride has a high affinity for moisture, the atmosphere of this first jar can be considered as relatively dry. Under these conditions, the cobalt-chloride paper will be blue.

Place some ordinary water in the second jar and drop the second strip of cobalt chloride paper into the enclosed tube. When the cap is screwed in place, this jar will contain a moist atmosphere and the test paper will be pink.

As a final test, open both jars, interchange the paper strips, and then replace the caps. The pink strip now in the dry jar will soon turn blue and the blue strip will become pink.

Because of its tendency to change col-

Above, strips of paper saturated with cobalt chloride change color to indicate changes of humidity. Right, how the "dry" jar is made. This experiment shows why the dress of the "weather doll" changes color when there is a change in the amount of moisture in the air



HOW SO-CALLED "WEATHER DOLLS" WORK

or, cobalt chloride can also be used as the basis for a novel thermometer. Instead of indicating temperature by the length of a column of expanding liquid it will reveal temperature changes by a change in color. To demonstrate this, a few cobalt-chloride crystals should be dissolved in a small quantity of denatured alcohol (radiator alcohol). Because the alcohol will abstract the combined water from the crystals, the resulting solution will be blue.

The solution should then be heated and afterwards cooled by adding water, a drop at the time, until a faint pink color appears. This resulting pinkish liquid will exhibit a strange sensitivity to temperature changes. Held in the hand and shaken, a test tube of the liquid will change from light pink to light blue. Heated with a match, the liquid will turn a still deeper blue. Allowed to cool, it will return to its original light pink hue. In fact, a test tube of the liquid, if stoppered to prevent evaporation, can be used as a rough form of thermometer. A standard temperature chart can be prepared by heating it gradually and matching the corresponding colors with mixed water colors.

This color-changing quality of a cobalt-chloride solution also makes it valuable as a mysterious secret ink. As an experiment, write a few words on a scrap of paper with a clean pen dipped in some of the solution. When dry, the writing will be invisible but when the paper is heated, the characters will appear in blue lines. To make them disappear again blow your breath across the paper.

Because of the beautiful blue color it produces, cobalt is also an important ingredient in the manufacture of blue glass. Glass colored in this way is called cobalt glass and can be prepared by the home chemist by heating a piece of glass rod to red heat, touching it to a crystal of some cobalt compound, and reheating it. The cobalt then should be worked into the glass with a second glass rod. As the glass cools the beautiful blue color of cobalt will be clearly seen. The color is due to the blue cobalt silicate formed when the cobalt combines with the silicon in the glass.

The magnetic property of cobalt steel is shown by this device, in which a ring magnet is held up by the repulsion of like poles

Nickel likewise can be used to color molten glass. However, in this case instead of blue, the resulting glass will be brown.

Cobalt glass forms a valuable aid in making the various flame tests to detect the presence of unknown chemicals. As shown in past experiments (P. S. M., Mar. '33, p. 56), certain compounds can be identified by the fact that they tint the blue flame of an ordinary gas burner. For example, sodium compounds produce a characteristic yellow color while potassium gives off a violet hue. Viewed in the flame separately, it is a simple matter to distinguish one characteristic color from the other.

However, many times the two chemicals may be mixed and the combination of the two flames will be confusing. In

By
RAYMOND B. WAILES

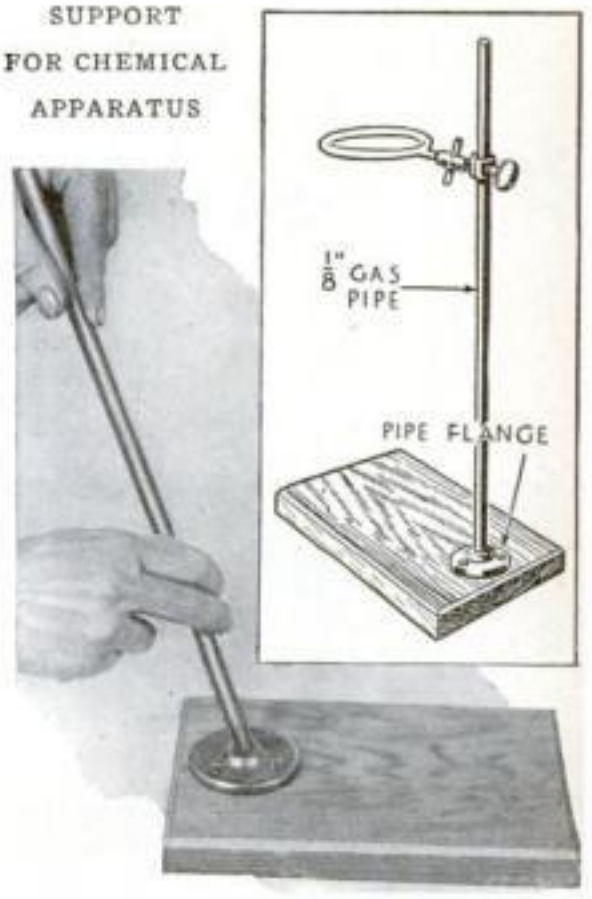
the case of a mixture of potassium nitrate and sodium chloride, for instance, only the characteristic yellow of the sodium will be plainly visible, the violet of the potassium being hidden by the yellow.

Fortunately, blue cobalt glass solves the problem. Serving as a filter, it eliminates the yellow of the sodium and brings out the violet of the potassium. Flame filters, made of cobalt glass and used to test for unknown chemicals, are on the market, but the amateur experimenter can obtain excellent results by simply cutting the bottom from an ordinary blue glass bottle. By mounting it in the convenient, yet simple, handle arrangement shown in the drawings, the cobalt-glass filter can be used in the manner of a magnifying glass.

Cobalt can be used in still another way to detect the presence of potassium compounds. To demonstrate this, prepare a solution by dissolving fifteen grams (about three teaspoonfuls) of cobalt nitrate and twenty-five grams (about five teaspoonfuls) of sodium nitrite in seventy-five cubic centimeters (one third of a glass) of water to which five cubic centimeters of glacial acetic acid (100%) are added. When this test solution is added to any solution containing potassium, a telltale yellow precipitate will be formed.

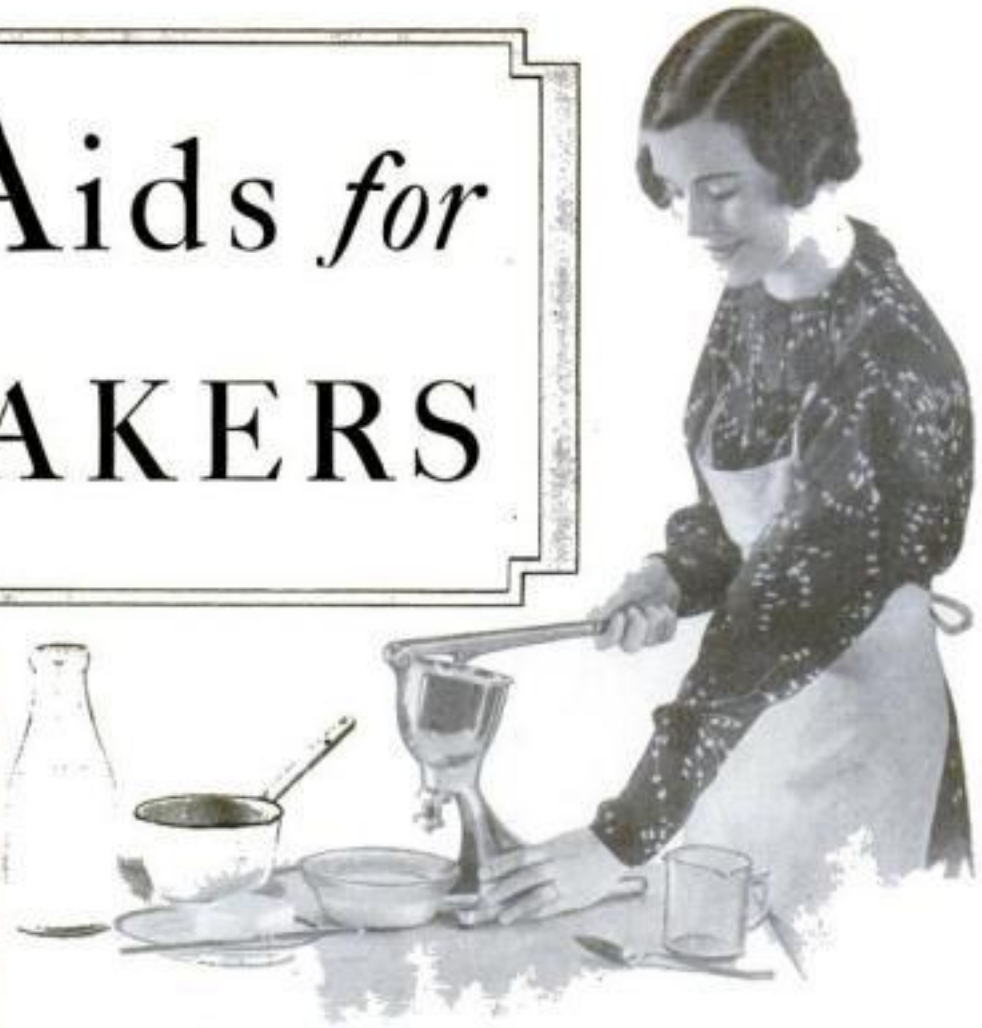
As already described (P. S. M., Mar. '34, p. 54), cobalt also performs an important part in the blowpipe analysis to detect the presence of zinc and aluminum. The substance to be tested is placed on a charcoal block and heated by the hot flame developed when a blowpipe is used with a gas *(Continued on page 118)*

SUPPORT FOR CHEMICAL APPARATUS



A strong support for chemical apparatus can be made by screwing a ⅛-inch pipe flange to a wooden base and adding a length of pipe

Handy Aids *for* HOMEMAKERS

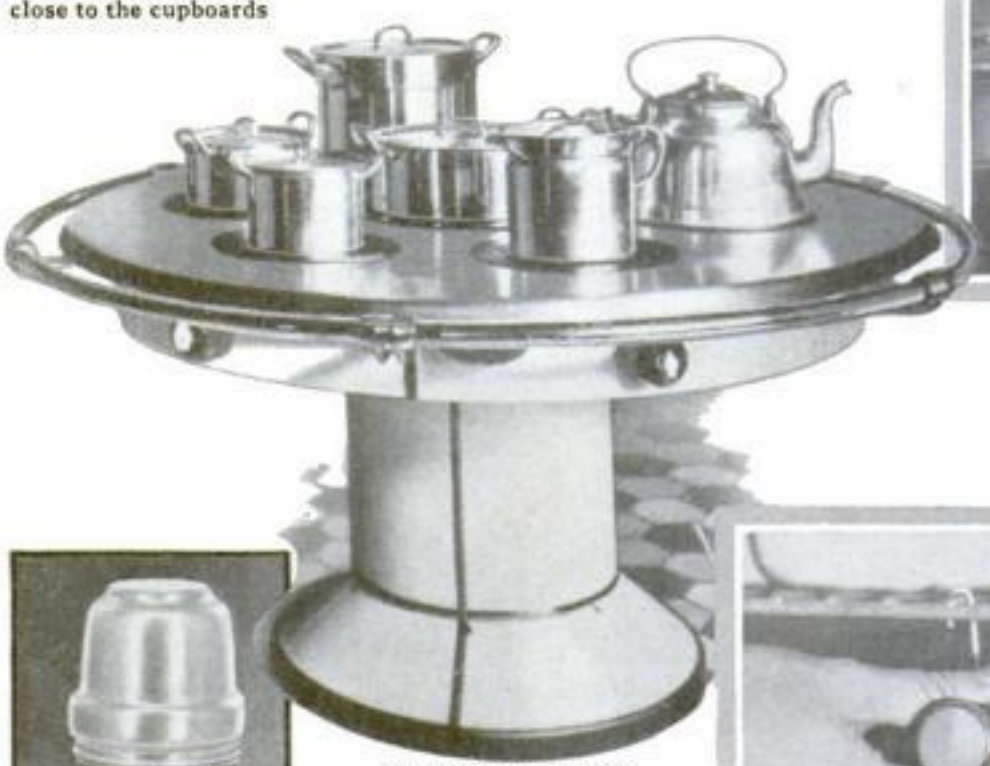


HOME CREAM MAKER. Half a pint of milk and one ounce of butter, mixed in the device shown above, produces a quantity of delicious cream. In the mixer is a small cylinder with a lever-operated piston. Working the handle forces the mixture through openings in jets to form cream

DUST CAN. So that the bag of a vacuum cleaner may be emptied without inconvenience, a dust can, with a top that fits the bags of standard vacuum cleaners, has been introduced. When the dust can is full its contents are disposed of at one operation

PEDESTAL STOVE

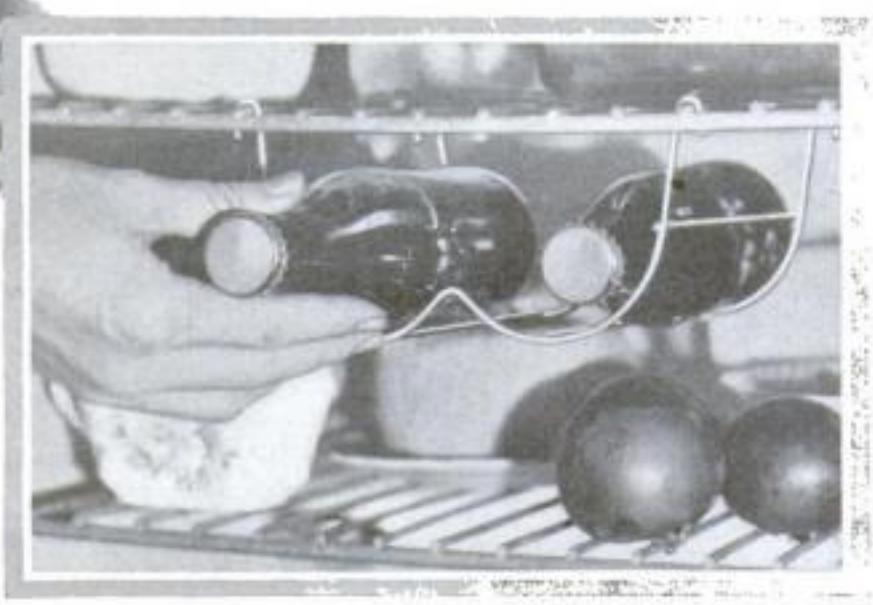
The circular electric range pictured below is accessible from all sides as the stove rests upon a pedestal. Since no flue is required, the stove may be placed in the center of the kitchen, close to the cupboards



CLOCK TIMES PHONE CALLS. Colored lights around the rim of this electric clock are used to time long-distance phone calls. When a button is touched, as shown, a red light appears opposite "12." At fifteen-second intervals a green light appears at "1," "2," etc. A yellow light means time is nearly up

DOUBLE-WALLED CUP ON BOTTLE

A hot drink can be poured into the cup on the vacuum bottle, left, without burning the fingers as the cup has a double wall with a dead-air space that retains the heat. The cup works on a principle similar to that found in the average vacuum bottle



BEVERAGE RACK. Two bottles of beer, or other beverage, are held in this rack which is quickly attached to refrigerator. It is designed to utilize space usually wasted

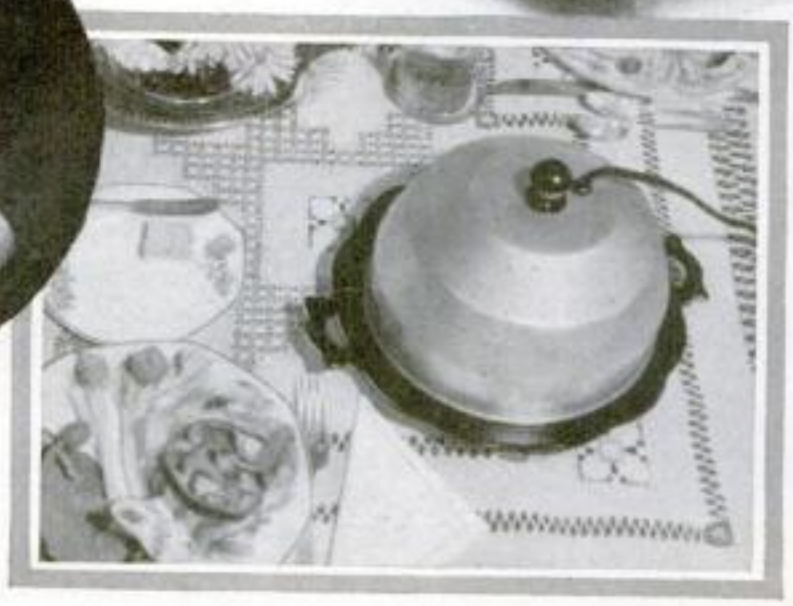
ARTISTIC PHONE CABINET. The phone's bell box is concealed behind a perforated grill in this ornamental cabinet. A rack, holding the telephone book, may be opened as a writing desk. Light is provided by a hidden dome lamp

REFRIGERATOR TRAY LIFTS OUT. The tray shown above folds flat against the inner side of the refrigerator door when not in use. At a touch it drops to a horizontal position and when loaded with delicacies it can be lifted out and carried to the dining room

ELECTRIC DISH WASHER
A hand hose, squirting a jet from a nozzle of special design, aids this electric dish washer in removing food quickly from dishes

WASHABLE WALL PAPER. Mild soap and warm water quickly remove soot and finger marks from the wall paper that is illustrated above. It is said it can be washed repeatedly without dimming its designs

BOTTLED WHIPPED CREAM. Bottles like those used for seltzer are now being filled with cream. After cream is in the bottle, inert gas is pumped in under pressure. When the valve is pressed, the gas pressure whips the cream as it is forced out



PORTABLE BRIDGE LAMP
Shedding its light where it is needed, the bridge lamp shown above, is ready for use when balanced on the corner of the table. The weighted arm keeps it from falling over

KEEPS FOOD WARM
Dropping this electrically heated dome over a dish of food keeps it hot after it has been placed on table. Its heating element is actuated by the house current

Question: Who was the smallest human being? E. L., Moline, Ill.

Here's *the* Answer

A.—SMALLEST of all dwarfs was the English midget Jeffery Hudson who was born in 1619 and died in 1682 after an adventurous life spent with kings and queens. Until the age of thirty, he measured only a foot and a half. One of his most harrowing experiences was a deadly hand-to-hand duel with a full-grown turkey cock which he was lucky enough to defeat.

Angleworm Farm

W. J. B., SAULTE STE. MARIE, ONTARIO, CAN. Strange as it may seem, farms for breeding and raising angleworms do exist. This novel industry, having an output of more than a million worms a year, centers in Alhambra, Calif. The worms are fed entirely on corn meal. When shipped, they are packed in moss-filled tins. Even the fish, it appears, get their food, like human beings, out of cans these days.

Just 1,800 Too Many

Q.—IS IT true that there is a thunder and lightning storm in progress somewhere on the earth's surface every second?

A.—ACCORDING to a recent check, it was estimated that at least 1,800 thunder and lightning storms are flashing over the earth every instant. To produce the electricity wasted by any one of these storms would cost about $30,000.

Seeing is Deceiving

Q.—IF THE stars are round, why do they appear to be pointed? Also, what makes them flicker on and off?—L. P., Bronx, N. Y.

A.—WHEN you consider that it takes the light from the nearest star more than four years to reach the earth, it is not hard to imagine that all sorts of things can happen to the light beam along its way. Stars appear to wink because the density of the air is not uniform. This causes the light beam to waver. As to their pointed shapes, this is attributed to a mistake of our eyes. The same effect will be noticed when a street lamp is viewed through a window screen, the fine wires producing the star shape.

Small But Heavy

Q.—WHAT is the name of the smallest star in our universe?—K. D., Chicago, Ill.

A.—VAN MAANEN'S star. It is not only the smallest known star but also has the distinction of being one of the densest. According to one noted astronomer, some five tons of it could be crammed into a small match box. Although little larger than our earth, it is approximately 50,000 times heavier. It is a dwarf star, which means that it probably is a very old and nearly burned-out sun.

Nature's Balancing Act

Q.—WITH balance playing such an important part in airplane design, how is it that birds can continue to fly when they molt even though they may lose two or three large wing feathers at the same time?—D. B., Denver, Colo.

A.—ONE theory is that a bird's wing feathers are lost in pairs during the molting season. When a feather drops from one wing, a corresponding feather automatically drops from the other to maintain the balance and enable the bird to fly.

Insects' Board Bill

J. B. K., ALBANY, N. Y. The board bill for grasshoppers in four western states totaled more than $17,000,000 in 1933. Damage caused by the insects in Montana reached approximately $3,000,000; in North Dakota, $10,250,000; in South Dakota, $3,600,000 and in Wyoming $250,000. During recent months, experts of U. S. Department of Agriculture made a survey of infested states, determining the number of eggs in test sections of the soil as a guide to the work of combatting the insects and checking their ravages.

Hermit Crab is a Hobo

L. N. P., ST. LOUIS, MO. Although the hermit crab is partially protected with an armor, his hind quarters are soft and easily punctured. For this reason, he always takes refuge in an old vacant shell, carrying it around on his body as a defensive covering. Hermit crabs have been found with bodies housed in hollowed stones, small tin cans, and broken bottle necks.

Foiling Tree Bugs

W. M. M., LAKEWOOD, O. To prevent insects from crawling up trees and attacking the foliage, the following mixture should be smeared around the trunks to form a three-inch wide band: twelve parts of pitch, ten parts of rosin, and two parts of rosin oil. The mixture should remain sticky at temperatures as low as 40 deg. F. and should not run when the heat sends the thermometer to 130 deg.

When Paint Crawls

F. G. H., INDIANAPOLIS, IND. When paint crawls, it generally is caused by a greasy or oily surface. To prevent crawling, wipe the surface with a gasoline- or benzene-soaked cloth. Then wash it with a strong solution of sal soda and water, and finally rinse it with clear water. The boards should be allowed to dry before the paint is applied and well brushed on.

Plane in a Loop

Q.—WHEN a plane having a gravity-feed fuel system loops the loop, what forces the gasoline to the carburetor?—L. S., Reading, Pa.

A.—CENTRIFUGAL force takes the place of gravity, forcing the fuel out toward the motor. For continued upside down flying, however, some sort of pressure fuel feed is necessary.

—And Worth Plenty

V. N. HILO, HAWAII. Ambergris is white, ash-gray, yellow, or black and often variegated like marble. It has a waxy consistency and a disagreeable odor which gradually sweetens after exposure to the air. It will

dissolve readily in hot alcohol to form a brilliant crystalline substance called ambrein. Any manufacturer of perfume is a likely buyer for ambergris if you are so fortunate to find some of it, which occasionally washes up on shore.

Bluing Gun Barrels

J. W. S., JACKSONVILLE, ORE. A solution for bluing gun barrels can be made by dissolving two parts of crystalized iron chloride, two parts of solid antimony chloride, and one part of gallic acid in four parts of water. Apply the solution with a sponge and allow it to dry, repeating the process several times. Finally, wash the barrel thoroughly, allow it to dry, and rub it with boiled linseed oil to deepen the color.

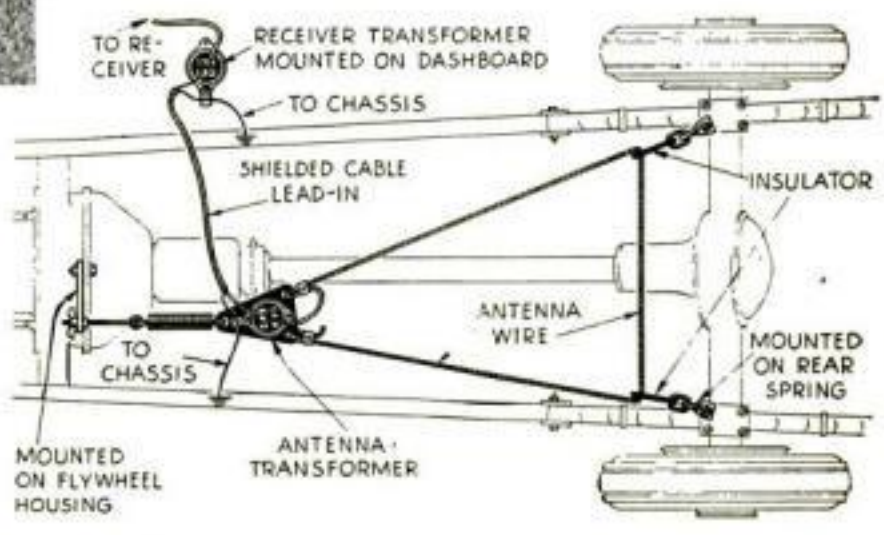
He'd Weigh A Hundred

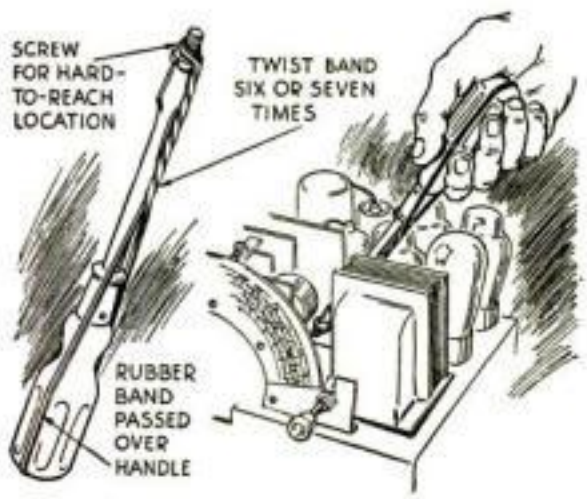
Q.—A BOY weighing one hundred pounds is riding up in a uniformly accelerated elevator. Would the downward pressure of his feet on the floor be *(Continued on page 115)*

Useful Hints *for* Radio Fans

New Antenna Helps Auto Sets

BY USING the modern antenna system illustrated, an automobile receiver can be supplied with clear, noise-free signals. Designed along the lines of the large interference-eliminating antennas recently described (P. S. M., Mar. '33, p.60), the system consists principally of a shielded lead-in and two lightweight impedance-matching transformers. The shielded lead-in prevents man-made static noises from entering the system by that route while the impedance-matching transformers prevent any losses in signal strength. Fastened under the chassis between shock-proof mountings, the antenna is sturdy and covers a larger area than other under-the-car types. Another new car attachment automatically increases the charging rate of the car's generator by five amperes every time the radio is turned on.





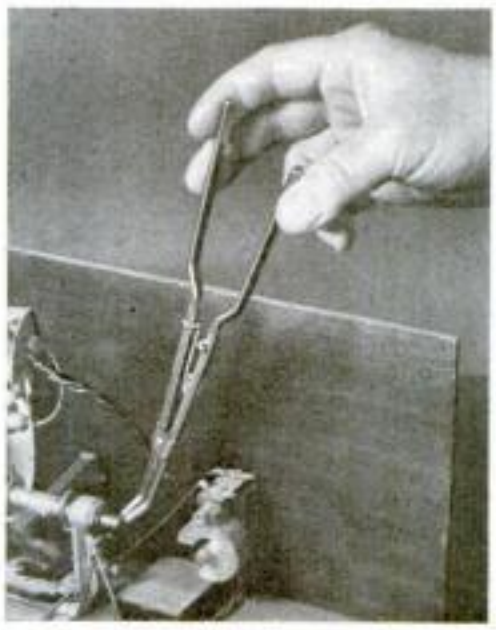
Installation of this improved auto antenna is easy and it needs no attention. Diagram at right shows how it is attached to frame of car, and the hook-up of the transformers

Rubber Band Holds Screw

ALTHOUGH many types of automatic screw-holding screw drivers are available on the market, the home set builder can improvise a handy substitute in emergencies by adding a thin rubber band to his regular screw driver. As shown in the illustration, the screw first is placed on the blade of the tool. Then a thin rubber band is looped over the threaded shank, twisted six or seven times, and finally hooked over the top of the screw driver handle. If the screw driver blade fits the screw slot as it should, the rubber band will hold the screw firmly enough to allow it to be started in its nut. Once started, the screw can be freed simply by loosing the rubber band from the top of the screw driver. With large screws, use two rubber bands, one on each side of the screw driver handle.—W.M.

Shadow-Line Dial Tuning

FOR shadow-line tuning on any illuminated translucent dial, make a shield for the lamp with a square hole as shown at the right, and solder a fine wire vertically across the hole. The wire will throw a shadow on the dial.—W. E. McL.



Long-Nose Pliers Have Spring Lock

INEXPENSIVE long-nose pliers that can be purchased at most hardware counters form a valuable addition to the amateur's tool kit. They are particularly useful when working in the depths of a crowded circuit; wires can be held for soldering, screws can be lowered into holes, nuts can be held over screws until the threads catch, and small parts can be pushed into place. The pair shown above, bought for ten cents, is particularly useful since a strong spring arranged on the arms pushes the jaws together when the grips are released.

Attractive Name Plates Made from Laminated Celluloid

WITH a sharp knife and some scraps of laminated celluloid, the amateur set builder can provide his receiver, switchboard, or transmitter panel with durable labels and name plates. The celluloid, of the type having a white center and black or dark-colored outside layers, can be obtained from almost any manufacturer of sheet celluloid or it can be salvaged from celluloid novelties. The lettering is made by cutting through the outer colored layer with the point of a knife. As the outer lamination is cut away, the white inner layer shows through to give neat white letters on a dark background. The plates can be mounted on wood with small escutcheon pins driven through small holes drilled in the ends. If they are to be mounted on metal or hard rubber, the escutcheon pins can be riveted over on the back side. This same kink can be used in making professional-looking dial pointers and scale graduations.—B. R.

This picture shows how name plates and labels can be made by cutting the letters into celluloid

Suit-Case Transmitter
COVERS THE WORLD

Powerful transmitter, weighing only thirty pounds, can be carried easily

ONE hundred watts of radio power crammed into a small suit case. That is what you will have when you complete the portable short-wave transmitter illustrated.

Although it measures only 10 by 15 by 17 in. and weighs less than thirty-five pounds complete, this powerful unit, set up in America, has repeatedly contacted short-wave stations in Cuba, Hawaii, Australia, Alaska, Japan, Canada, and South America. Because it has this world-wide scope and can be constructed for less than fifty cents a watt, it forms an excellent unit for the amateur who wants a permanent rig that will combine the features of a portable outfit as well.

As to its cost, with a little shopping around the parts for the original were assembled for $46.36. Although this price does not include the antenna-output ammeter, this unit was installed only because it happened to be handy. It can be eliminated without reducing either the power or the convenience of the transmitter.

As shown in the circuit diagram, four tubes, one type '47 and three type '10s, are used in the transmitter proper. The built-in power supply, which by the way can be used to supply the needs of a short-wave receiver as well as the transmitter, requires two type '83 rectifier tubes.

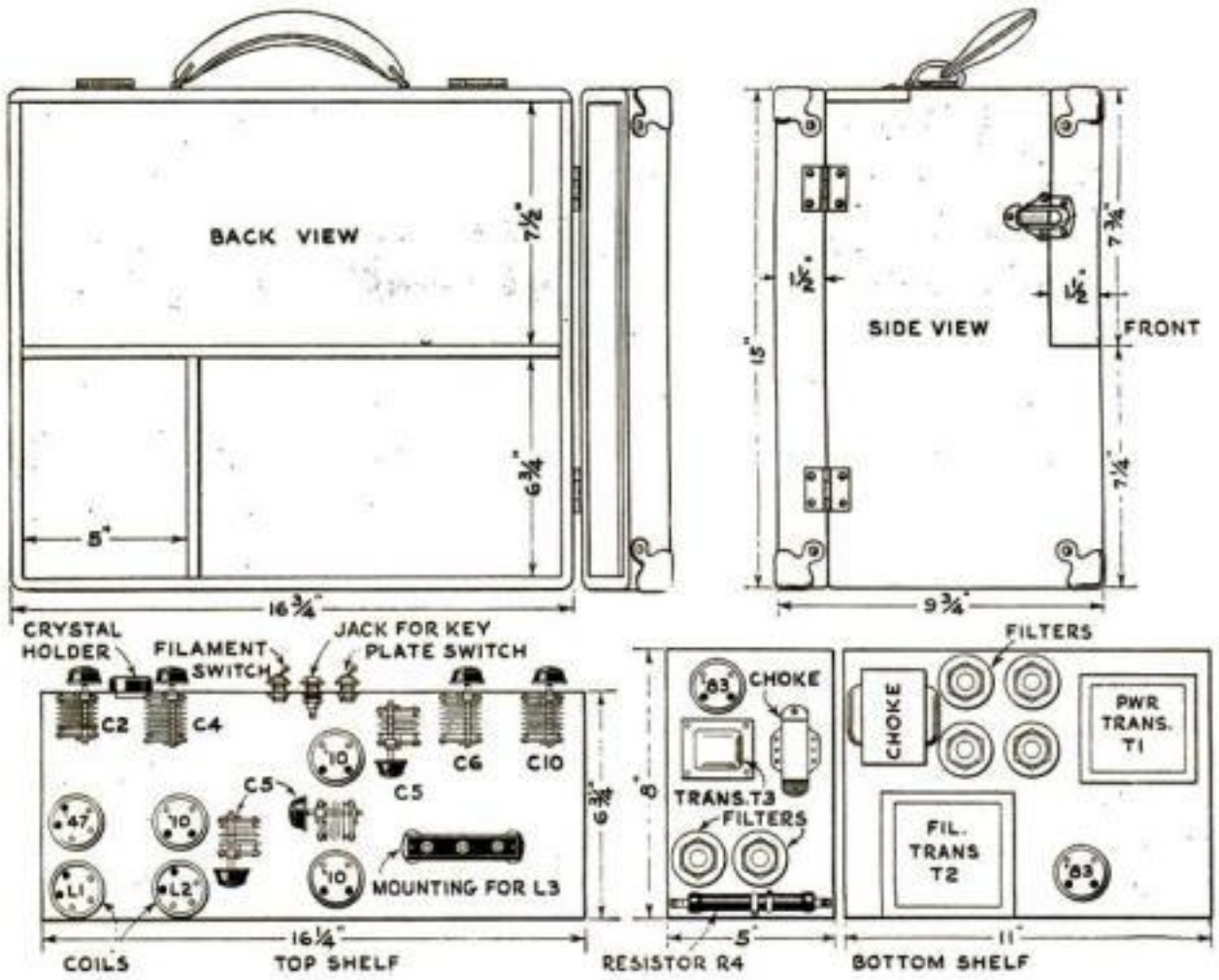
The first job in building the transmitter will be to find a suitable case. This can be made from plywood or can be purchased. The writer used a leather-covered case salvaged from an old portable receiver, but a wood-frame suit case costing two or three dollars will serve the purpose just as well. If a suit case is used, the cover will act as the rear door of the transmitter while the control panel can be set into the opposite side.

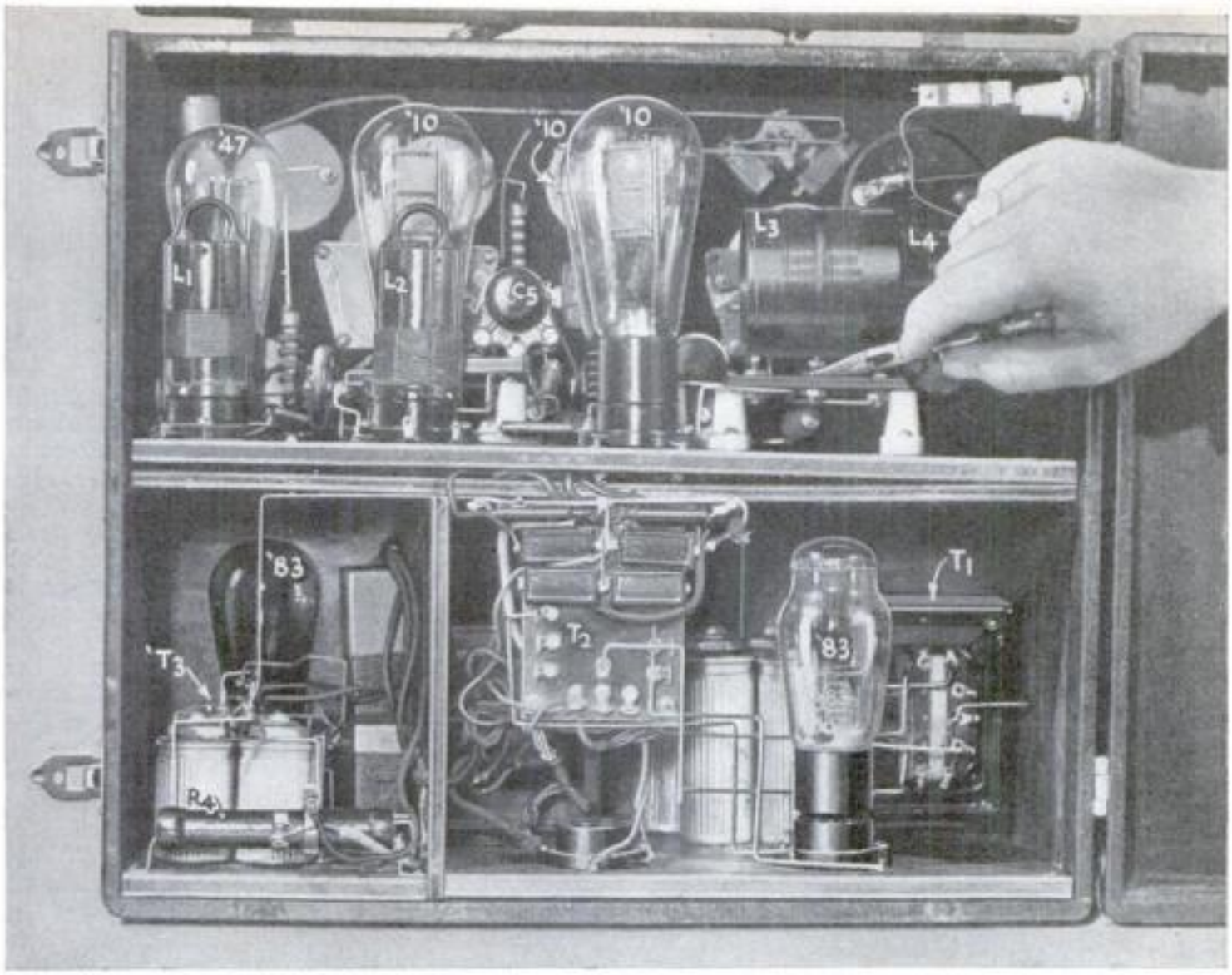
To simplify the original wiring and allow for future repairs or additions, the transmitter circuit proper should be mounted on a separate panel and base unit made to slide into the case where it is held in place with screws. The panel, measuring 7½ by 16¼ in., can be composition wood or rubber composition and the 6½- by 16¼-in. base, can be made of a piece of three-ply board (¼ in. thick). Three screws, placed as shown in illustration, will hold the assembly together.

Once the panel and base are ready, the various parts in the transmitter circuit should be mounted as shown in the drawings and photographs. First mount the variable tuning condensers, meters, switches, key jack, and crystal holder on the front panel. Then follow by fastening the various tube and coil sockets, the neutralizing condensers, and the final coil mounting (L3) to the baseboard. The small fixed resistors, fixed condensers, and radio-frequency chokes can be mounted as the wiring progresses. Because it is rigid, bus wire should be used in making the connections.

By utilizing an ordinary wafer type socket, a neat mounting for the quartz crystal oscillator control can be made. Mount a five-prong socket on the rear of the panel in such a way that two of its holes coincide with two holes drilled in the control panel to take the crystal-mounting prongs. The crystal holder then can be plugged in or removed easily. The specifications of the crystal, incidentally, will depend on the frequency to be covered by the transmitter. In most cases a forty-meter crystal will cost from three

Below, construction views of the cabinet and the layout of the shelves. Upper right, portable outfit with power plug inserted and ready for action





By
FAUST
GONSETT

Amateur Station W6VR

LOOKING INSIDE THE TRANSMITTER

Left, view of the transmitter with the rear door removed. The radio frequency portion occupies the upper shelf and the power supply the lower shelf. Pencil is pointing to the plugs that are used in mounting the antenna coil

to four times as much as a crystal designed for eighty-meter operation. However, some eighty-meter crystals will operate equally well on forty meters because of the doubling action in the buffer stage of the transmitter circuit. To be sure that the eighty-meter crystal will double to the forty-meter band, multiply the crystal frequency by two. If the result falls between 7,000 and 7,300 kilocycles, the crystal can be used in both the eighty- and forty-meter bands.

The combination power supply is mounted on the lower shelf as shown. To provide good balance for the case, suspend the filament transformer T2 from the center of the shelf. Then T1 placed at one end can be balanced by T3 placed at the other end.

In the diagram for the power pack, the filter condensers are shown as being placed in series. This is done to bring the combined rated working voltage of the condensers above that of the circuit. When placing these condensers in series, make sure that the negative condenser lead is connected to the negative voltage lead. On condensers of this type, the can is always negative while the insulated center terminal is positive.

The keying of the transmitter is accomplished by interrupting the center tap of the 7½-volt transformer winding supplying the filaments of the push-pull type '10 tubes in the final stage. Known as "center-tap" keying, this method is simple and gives the instrument a sharp clean-cut note.

Besides acting as a B-supply for a short-wave receiver, the secondary power supply also serves as the C-bias pack for the buffer and final stages of the transmitter. The bias connections to the transmitter circuit are shown in the circuit diagram as the -C terminals. The common +C connection coincides with the -B lead to the transmitter.

To adjust the buffer biasing, first remove the crystal from its mounting. Then slide the -C *(Continued on page 110)*

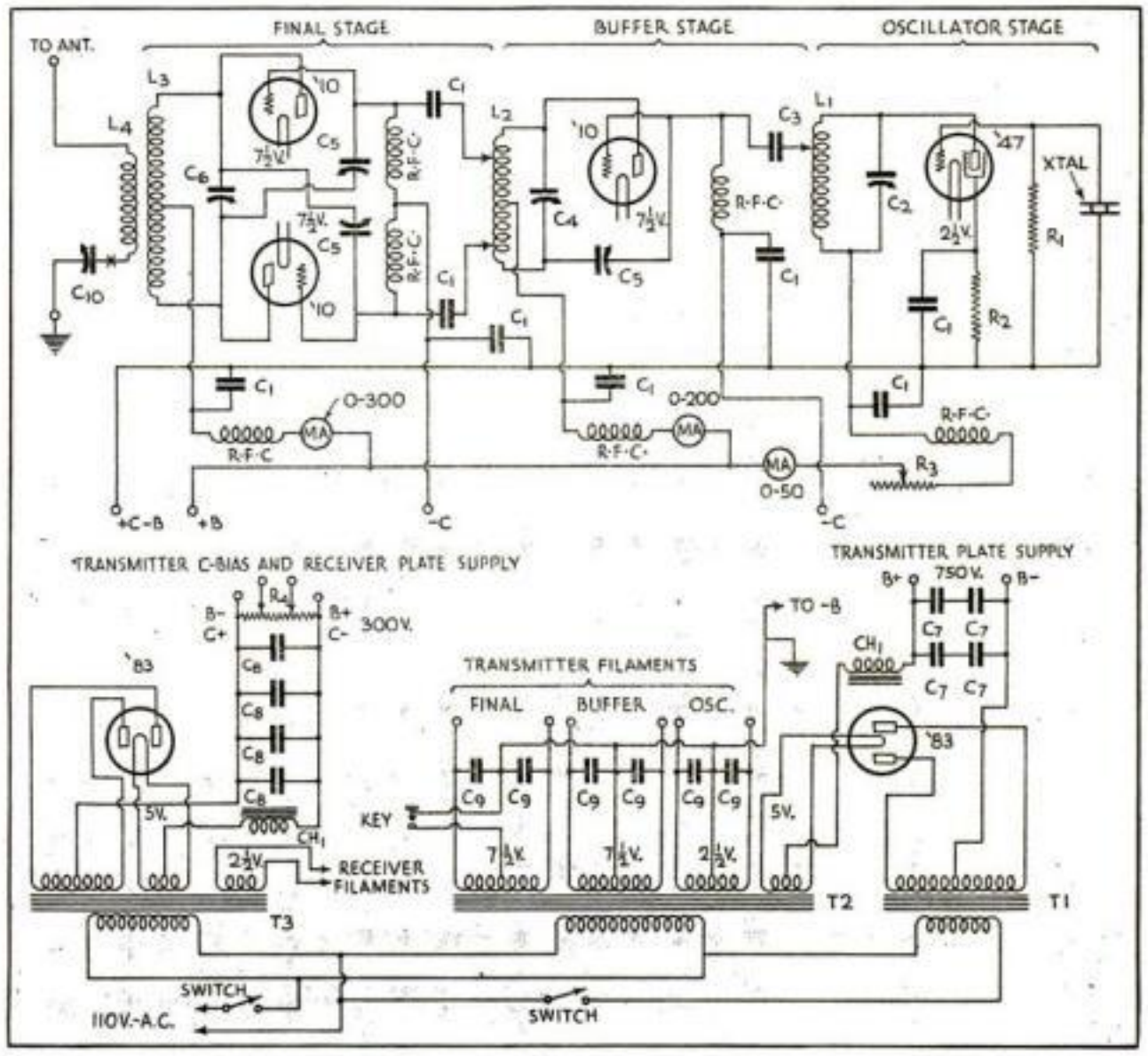
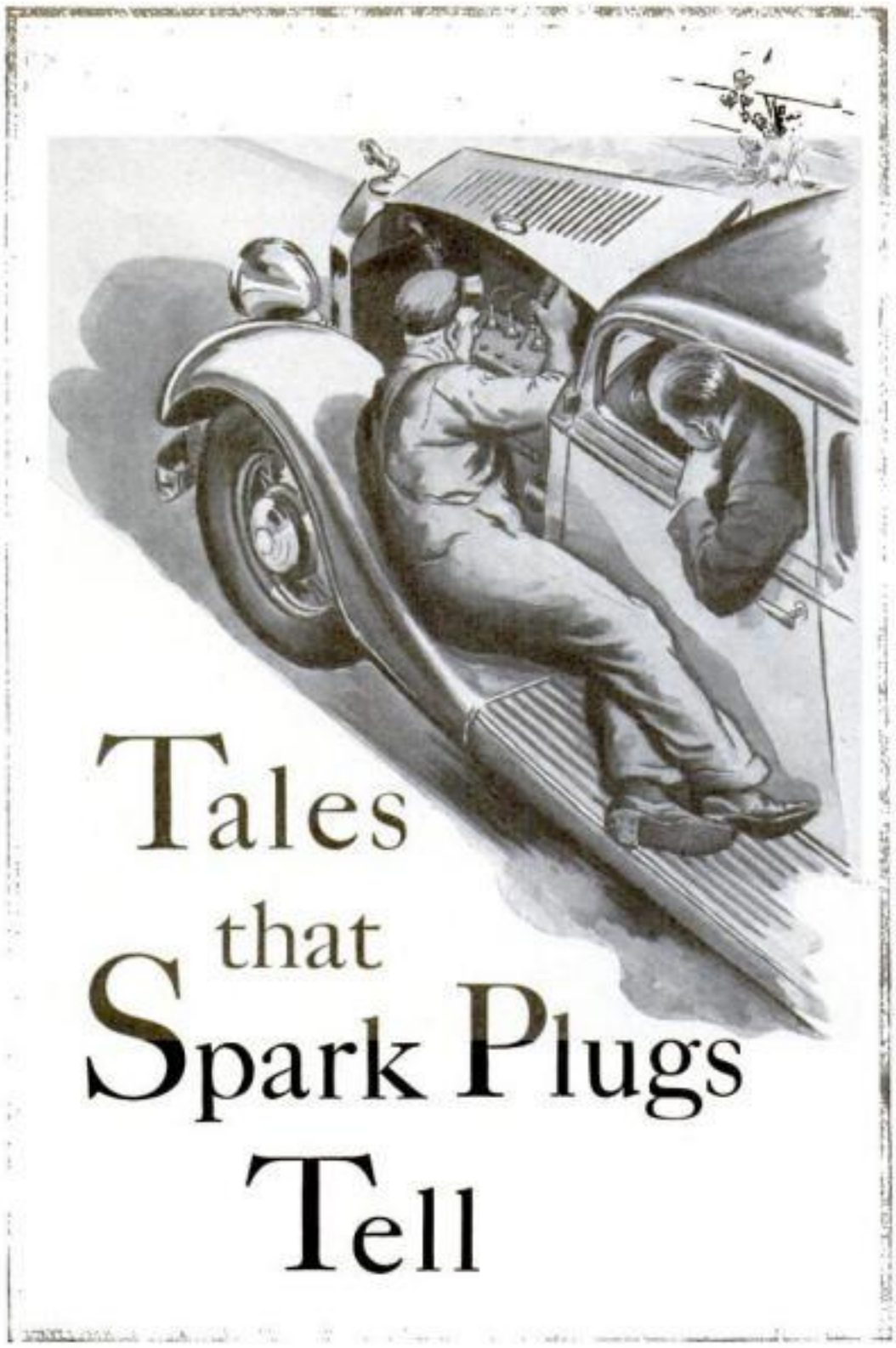


Diagram of the transmitter. Compare the reference letters with list published in text

By
MARTIN BUNN



Tales that Spark Plugs Tell

Gus Wilson short-circuited the spark plugs with a screw driver. "I think I've got it," he told the driver. "Pull over when you get a good chance and we will have a look"

WITH Gus Wilson perched on a front fender, Tim Barret drove his car up the steep grade of Bluff Hill. As the car gained speed, the veteran mechanic crouched closer to the open hood and the driver poked his head out of the window like an alert locomotive engineer.

"There it is. Hear it?" Barret shouted over the drone as the motor started skipping.

Gus nodded and reached into his overalls pocket for a screw driver. Listening intently, he short-circuited each of the six spark plugs that studded the motor block. With the exception of the last plug, the miss grew more pronounced each time the contact was made.

"O. K. I think I've got it," the gray-haired garageman shouted, jerking his thumb toward the spark plugs. "Pull over when you get a chance and we'll have a look."

"Funny thing about this car," Barret complained while Gus rummaged in his portable tool kit for a spark plug wrench. "She'll run fine for five or six days in a row. Then all of a sudden, she'll develop that miss every time she takes a hill. What gets me is that it disappears as quickly as it comes."

"Sort of takes a vacation now and then," suggested Gus with a grin. "Been acting that way long?"

"Not particularly," replied Barret. "Noticed it first about three weeks ago when I was down at the beach on my vacation. She acted that way for days at a time down there, but since I've been home, I haven't noticed it so much."

As Barret talked, Gus touched the base of each spark plug, wetting his finger tip as a housewife does when testing a hot iron. Finally, he slipped the head of the socket wrench over the last plug in line and with a steady tug loosened its threads.

"How about dirt in the carburetor?" the owner suggested. "That'll make a motor miss, won't it?"

In his casual preoccupied way, Gus lifted the spark plug from its hole in the cylinder head and rubbed a knowing thumb across the tip of the insulator. Then, after a careful inspection, he screwed it back into place.

"Unless I miss my guess, it's the ignition wiring," he said finally. "As long as I've got an extra set here in my tool kit, we might as well stick them in and see what happens. While we're here, we can try it out on this same hill."

A half hour later a second trip up Bluff Hill proved that Gus was right. The new ignition wiring completely eliminated the miss. In fact, the whole car seemed peppier and more powerful.

"That sure turned the trick," agreed Barret as the two men started their trip back to the Model Garage. "But I still don't see how bum ignition wiring could make a car run the way this one did. Why didn't all the cylinders miss, and how come the trouble only showed up now and then?"

"Sort of a combination of circumstances," explained Gus. "In the first place, only one piece of that ignition wiring was bad. For some reason or other, it was resting smack on the motor and the heat just naturally rotted the insulation.

"When it was dry, it held up, but when there was a lot of moisture in the air, the water saturated the spongy spots and made a short circuit to the motor head. Naturally, the juice was shunted away from the spark gap and the motor missed.

"Down at the beach it was probably damp, especially at night when the fog rolled in, so the short circuit was there most of the time. When you came back here where it's drier, she only acted up when it was muggy and rainy. Chances are, that heavy rain yesterday is what made it miss today."

"What gave you the hunch it was the wiring?" put in Barret, interested.

"The usual symptoms," replied Gus.

"Symptoms?" repeated the man. "Why, all you did was look at one of the spark plugs. What sort of symptoms can you see by looking at those greasy things?"

"You wouldn't think a doctor could tell much by feeling a patient's pulse or looking at his tongue, but he can," pointed out Gus. "When I found out which cylinder was missing, my first hunch was a fouled spark plug. When I saw that it was fairly clean and just a bit wet, I decided that something else was keeping the juice from reaching the gap. The distributer was O. K., so my next guess was the wiring."

"Simple when you know how, isn't it?" said Barret, admiringly. "No wonder every one in the county knows Gus Wilson."

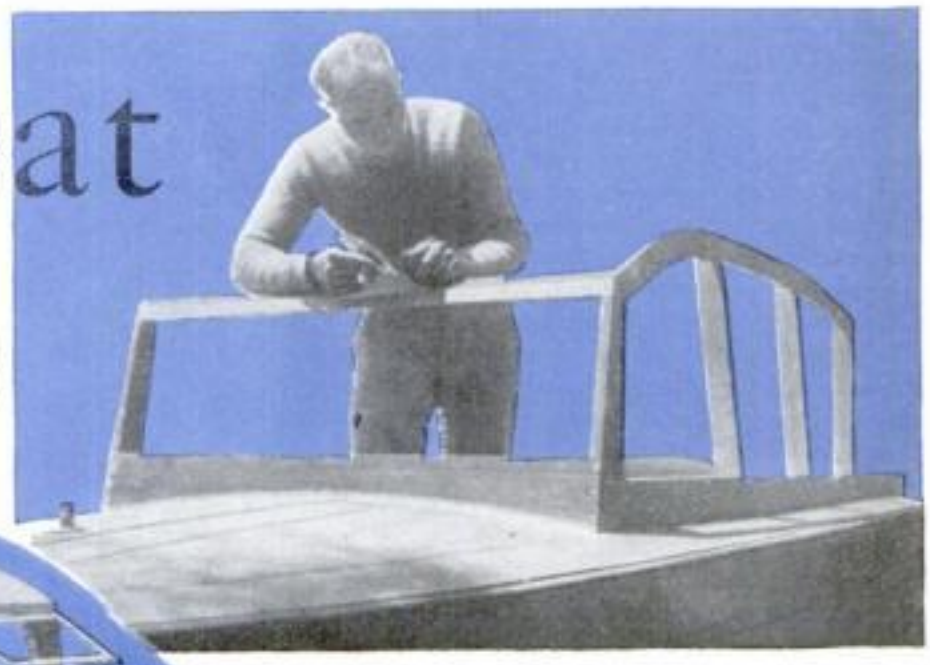
"Ever want to be a detective when you were a kid?" asked Gus, trying to ignore the compliment. "Well, finding out what ails a car isn't much different. First you've got to find the clews and spark plugs are good witnesses. They'll tell you about plenty of car troubles."

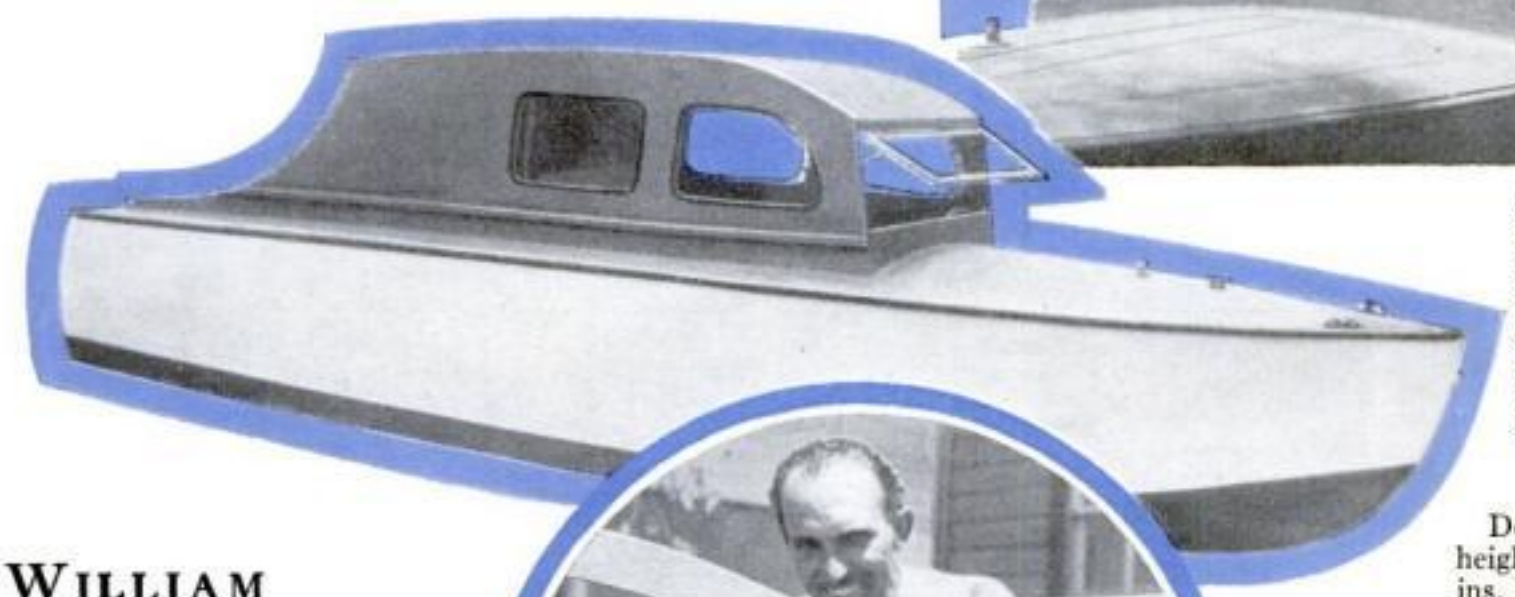
"I've never been able to see much difference in spark plugs," insisted Barret. "They all look alike."

"Not by a jug full," corrected Gus. "Every motor leaves its telltale marks on a plug that's been in use any length of time. Why shouldn't it, the spark-plug ends being right down there in the business end of the motor? They come in contact with everything that makes the car run—air, gasoline, oil, and electricity.

"Lots of people wonder why the gap terminals on their spark plugs wear down so fast. Generally it's an indication that the carburetor mixture is too lean. If the tips of the insulators are straw colored at the same time, it's a cinch that a lean mixture is causing *(Continued on page 118)*

Motorboat Cabins





A well-built cabin not only materially reënforces a boat, but also increases its utility in all kinds of weather and affords the smart appearance and protection of a motor car. Made as described, it adds very little weight

WILLIAM JACKSON

tells how to convert an open boat into a comfortable cruiser

How the windshield stanchion is fastened inside the coaming, and how the stringer joins the stanchion

MANY a good little craft, with merely the addition of a cabin, will make an excellent cruiser for hunting, fishing, or exploring the endless water highways where adventure beckons.

The cabin designs shown in the drawings are easily built, attractive, strong durable, and inexpensive. Their construction is not difficult and requires only ordinary tools. The photographs illustrate a comfortable cabin applied on the POPULAR SCIENCE MONTHLY "sportboat" (P. S. M., July '32, p. 67, and Aug. p. 78).

Small boats vary much in type and size, but for building a good cabin the hull should have the following attributes: It should preferably be of the V- or round-bottom type from 14 to 20 ft. long. The beam should be at least 4½ ft. The freeboard should not be lower than 20 in. amidships. If the hull has a good beam, the freeboard may be increased 4 in. or more by adding planks and frames to the hull. The drawings illustrate this.

If possible, make a full-size drawing of the boat and then draw the cabin design, being careful to avoid a high-sided appearance. The high-sided appearance may be decreased by adding a high coaming and building the cabin from the coaming up.

Do not overdo headroom height. For runabout cabins, have someone sit in the boat and hold a stick 2 or 3 in. above his head as a measure for the necessary headroom.

The best materials for the cabin framework are spruce, fir, white pine, yellow pine, and mahogany. For cabin sides and roof, use ⅜- or ½-in. white pine, cedar, cypress, mahogany, or redwood. The plank seams are joined as shown. The roof material may be from ¼ to ½ in. thick tongue-and-groove stock, or 6-in. widths clinch-nailed to a batten. An excellent material that readily adapts itself to cabin construction is one of the hard fiber or so-called "pressed wood" board compositions. It is light, durable, nonshrinking, strong, and easily worked. This type of board 3/16 or ¼ in. thick may be used for the cabin sides and roof.

Although the following dimensions are given for our own "sportboat," they may be adapted to any particular design of inboard or outboard boat.

To avoid a high-sided cabin appearance, the coaming in this case should extend 3½ in. above the deck. The entire width of the coaming is 7½ in., and it is ½ in. thick. This wide coaming firmly supports the cabin uprights. The coaming extends to within 6 in. of the transom. Fasten it in place with 1¼-in. No. 8 screws. All

the screws used in this work should have flat heads and be galvanized or brass.

The windshield should be from 17 to 20 in. high from the deck to the top of the windshield frame. The windshield stanchions are sawn out and notched as shown. The notch is only ¼ in. deep, as the ¼-in. pressed wood, when fastened to the windshield stanchions and uprights, will fit flush with the coaming.

The ¾ by 5 in. windshield coaming piece is fitted to the curvature of the deck and the windshield stanchions. This is fastened with 1¾-in. No. 8 screws.

The cabin stringers are cut from a ¾ by 10 in. by 6 ft. piece of yellow pine as shown. Measure and mark the board at 1-ft. intervals and drive nails at the points marked. When a light batten is sprung around the nails, the outline is easily marked, and then sawn out. Notch the forward end of the stringers as shown and fit to the windshield stanchions.

The ¾ by 2½ in. uprights are sawn out and notched ¼ in. deep to fit against the coaming and carlings.

Clamp the stringer at the stanchion, and clamp the No. 3 upright in place at the after end of the stringer. Fasten the stringer to the upright and to coaming with 1½-in. No. 8 screws. The top of the No. 3 upright is notched out for the cabin beam as shown. This is the only upright requiring to be fitted for the beams. Uprights Nos. 1 and 2 on both sides are now fitted and fastened in place.

The windshield toppiece is next notched into the stanchion and fastened with four 1½-in. No. 8 screws.

The ¾ by 1½ in. notched cabin beam is fastened with screws to the No. 3 upright. The remainder of the beams are merely straight pieces ¾ by 1½ in. These are fitted and fastened to the side of the Nos. 1 and 2 uprights, flush with the stringer. The remainder are screwed to the stringer midway between the uprights.

A ¾ by 1¾ in. reënforcing piece is fitted to the windshield toppiece as shown and fastened with 1¼-in. No. 8 screws.

Keeping the smooth side of the pressed wood sheet out, clamp it in place against the cabin sides so that the lower edge is even with the coaming and mark the outline. The part that extends aft of the cabin is marked to form a graceful curve. Saw one side out and use it as a template for the other.

A ¾-in. filler piece is fitted in place from the after edge of the stringer to the cockpit corner to hold the curved edge of the cabin side securely.

Reclamp the cabin side in place, mark the filler piece to correspond to the curve, remove, and saw to shape. Fasten the filler in place with 1½-in. No. 8 screws.

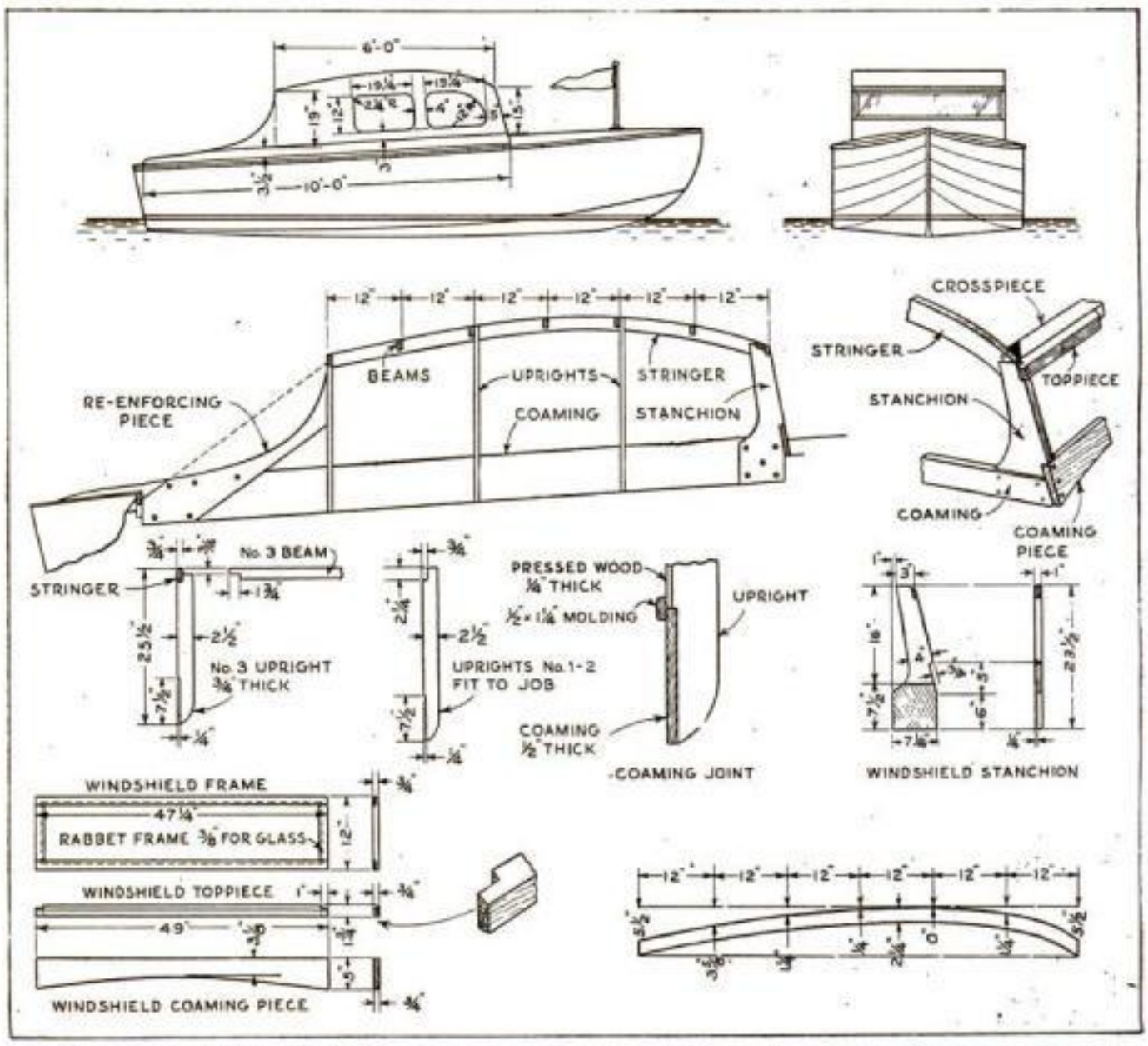
Mark the shape of the windows on the cabin sides, and saw out with a jig saw

The cabin framework set up on the hull of the *Popular Science Monthly* "sportboat," a trim, speedy outboard runabout

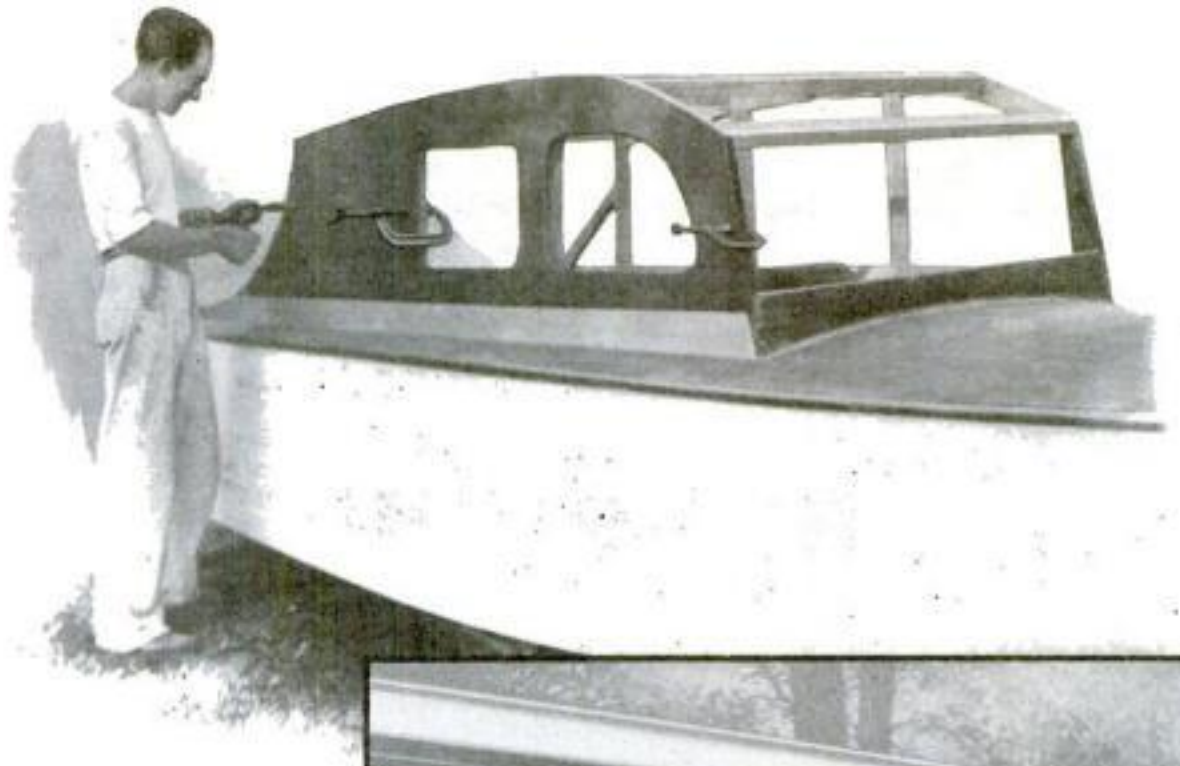
Countersunk holes are drilled for all screws, and slightly countersunk lead holes are made for nails

of a small keyhole saw. Carefully trim the edges smooth.

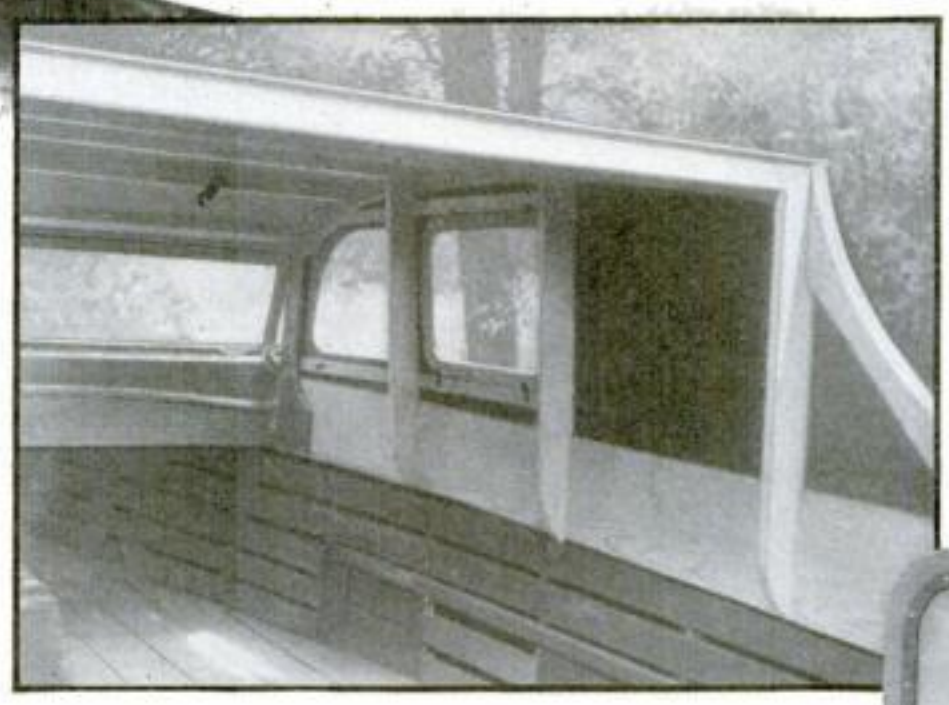
Clamp the cabin sides in place and fasten with 1-in. No. 8 screws spaced about 2½ in. apart. Drill lead holes and countersink the pressed wood for all screws. Trim and fair the edges. Before applying the roof, smear white lead along the top edge of the stringers and windshield toppiece. Starting at the toppiece, clamp the pressed wood sheet in place and continue to beam No. 3. Let ⅜ in. of the roof project at beam



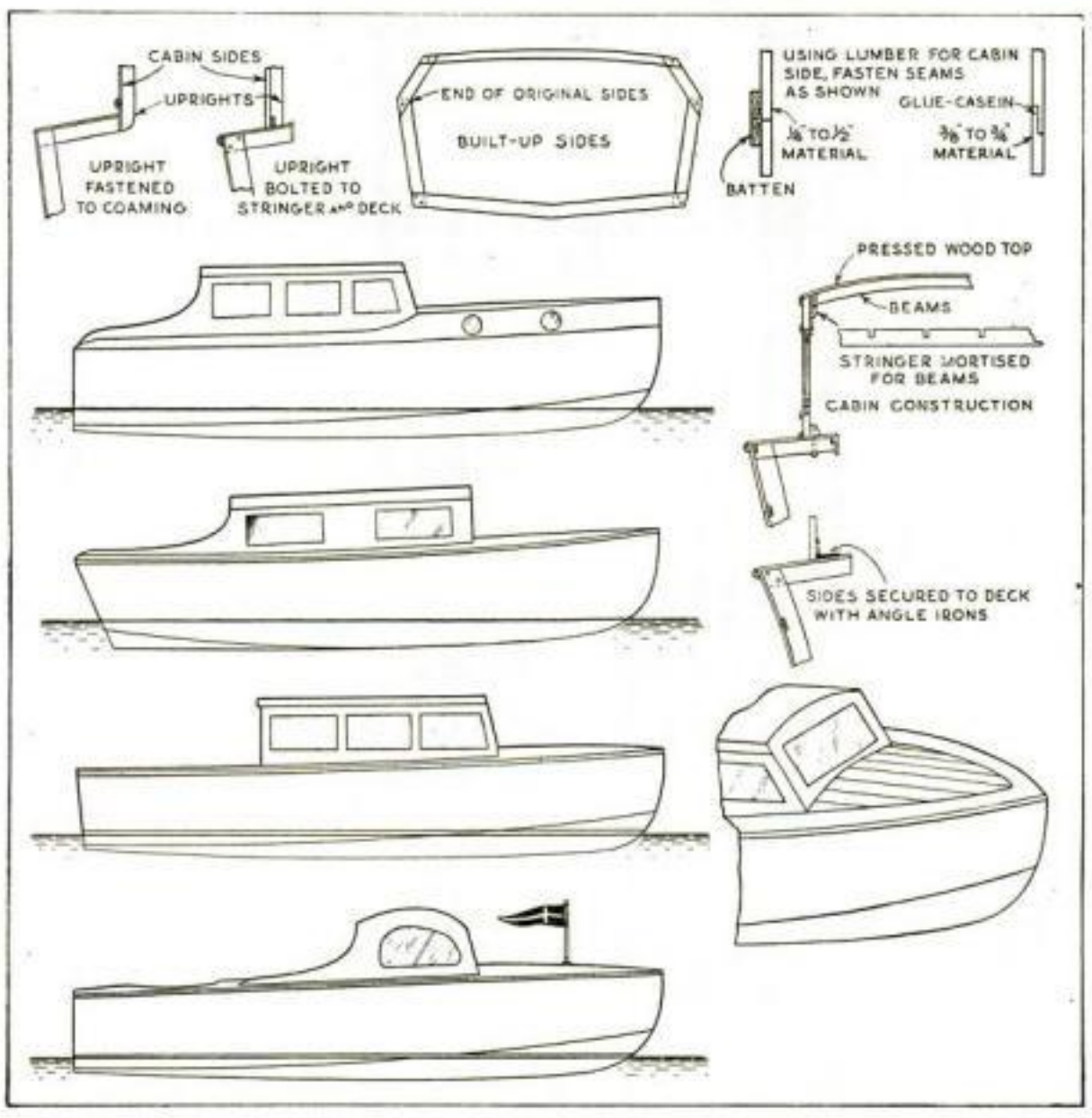
Drawings of the cabin as installed on the "sportboat." By changing the dimensions and making slight modifications, the same design can be applied to many outboard and inboard hulls. Note the width of the coaming



Applying one of the sidepieces. Mr. Jackson selected a pressed wood fiber board for both the sides and the roof because it is light, strong, nonshrinking, and easy to work



The interior of the cabin when finished. Note that uprights are notched ¼ in. deep to fit the coaming. The pressed wood board is fastened against them and makes a flush joint with the coaming on the outside



Four neat designs; two ways to mount the uprights; and methods of building up the sides, making joints in the sidepieces if lumber is used, securing the sides to the deck, and applying the roof

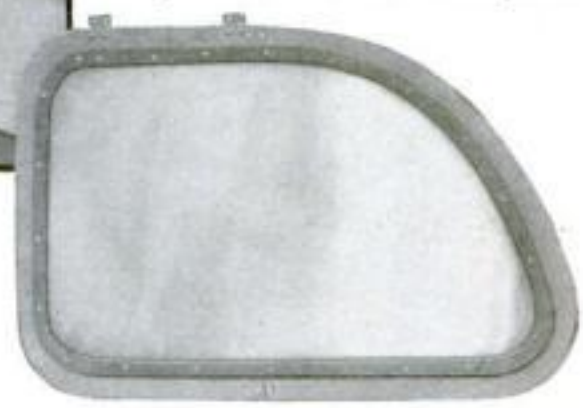
No. 3. Fasten the roof with 1-in. No. 8 screws spaced at 2½-in. intervals. Trim and sand the edges smooth. If it is necessary to use two pieces for the roof, place a ¾ by 1½ in. piece under the joint and fasten with ⅞-in. No. 8 screws.

The joint between the coaming and the cabin side is now made with a ½ by 1¼ in. piece fastened with screws from the inside. Round off the corners of this piece nicely, smear with white lead, clamp in place so it covers the joint equally, and fasten the pressed wood to the molding with ⅝-in. No. 8 screws, and through the coaming with ¾ in. No. 8 screws. Trim to fit evenly at the windshield and coaming.

The windshield frame is constructed as shown from ¾ by 1¼ in. mahogany, white pine, fir, or spruce. Use double-strength glass and fasten it in place with ¼-in. quarter-round molding, tacked with small brads. White lead smeared in the rabbet will cushion the glass and make a watertight job. Secure the windshield to the toppiece with 2½-in. brass butt hinges. Mortise the hinges into the windshield.

To hold the windshield in any position, use stay joints such as may be purchased in any large hardware store.

The window frames are sawn from scraps of pressed wood, and the joints secured with small pieces



One of the forward windows. They are cut from left-over pieces of composition board

of pressed wood, which are glued with casein glue and clinch-nailed with ¾-in. iron or copper clout nails. Half an inch of the frame extends inside the cabin window opening. An outer frame ½ in. wide that exactly fits the window opening is used to secure the celluloid window material to the frame. Clinch-nail the outer frame through the celluloid and inner frame with ¾-in. iron or copper clout nails, spaced about 2 in. apart.

Battens the same thickness as the pressed wood window frame, 1¼ in. wide, are clinch-nailed just above and below the window frame inside. Secure the window at the top with two 1-in. brass butt hinges to each window. Tabs made of pressed wood ½ by 1½ in. and fastened with small machine bolts hold the bottom of the windows securely to the cabin sides.

The after part of the cabin may be left open, or a roll curtain may be fastened to the top. If desirable, the entire after part of the cabin may be inclosed with pressed wood and a companionway door cut in.

Trim and sand all joints and apply three coats of paint, inside and out. Buff is a good color for cabin exteriors. To lighten the interior, paint it with light colors. A neat contrast may be had by varnishing the windshield and coaming.

Replica *of* Old-Time Well

IS STORAGE PLACE FOR GARDEN HOSE

Within this picturesque old well, a regular hydrant and a long garden hose are concealed

BUILT at very little expense, this replica of an old-fashioned well makes an unusual garden ornament. It also has a practical value because it is built around a water standpipe, and the garden hose, when not in use, is left fastened to the water faucet and coiled inside the well. A cover is built into the brick about 10 in. from the top of the brickwork.

The first step is to run an extension water pipe to the spot where you wish to build the well. Do not let the top of the water hydrant extend more than 16 in. above the ground.

Next construct the windlass. If you have no lathe, the round pieces can be turned at any woodworking shop. However, the drum of the windlass may be made out of a log from a tree. The windlass is set up in position and braced temporarily while the bricks are being laid. Do not set it "square with the world" as it will look more artistic otherwise.

Next run a length of ½- or ¾-in. pipe from the center of your well to a spot where you want the surplus water to drain. Let the end in the well protrude about 2 in. above the ground level.

Thoroughly mix 16 parts of sand, 4 parts cement, and 1 part dehydrated lime; add water to make a rather stiff mixture and mix again. Start laying a double row of bricks, making the inside diameter 26 in., or the same distance as between the two upright 2 by 8 in. pieces. The well shown in the photographs was made three bricks wide part way up, but this is not necessary. Making it two rows wide requires about 250 bricks, while the other way more than 300 bricks are required. Knock a small piece off of one corner of each brick.

The hose coils up into a compartment with a cover. The construction is shown below

List of Materials

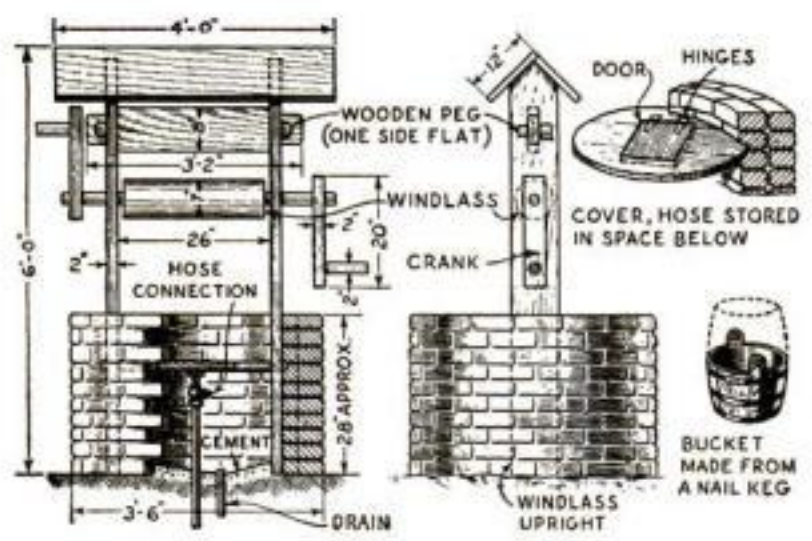
2—2 by 8 in. by 6 ft. for main uprights.
1—2 by 8 in. by 3 ft. 2 in. for cross brace.
2—1 by 12 in. by 4 ft. for roof.
1—1 by 12 in. by 8 ft. for cover.
1—1 by 3 in. by 8 ft. for cleats under cover.
2—2 by 4 in. by 1 ft. 8 in. for windlass cranks.
2—2 by 2 in. by 1 ft. 2 in. for windlass shafts (turn on lathe).
2—2 by 2 by 9 in. for handles (turn on lathe).
2—2 by 2 by 6 in. for wooden pegs.
1—8 by 8 in. by 2 ft. 1½ in. for drum (turn on lathe).
1—100-lb. sack cement.
1—50-lb. sack dehydrated lime.
Coarse washed sand.
250 common red bricks.
10 ft. of ¾-in. rope.
1 pair small hinges.
Water pipe.
1 nail keg.
Nails.
Water hydrant.

After the first tier or two of bricks are laid, cement the bottom of the well, sloping the surface so any water will run out of the drainpipe.

Continue laying bricks until you have seven tiers; then place the cover, which should be made in advance, on top of the brickwork. Three more tiers of bricks complete the masonry work.

Make your "old oaken bucket" out of an old nail keg. Set the bucket on the edge of the well and fasten a ¾-in. rope to it. The other end of the rope is wound around the drum of the windlass, and the extreme end is nailed to it.

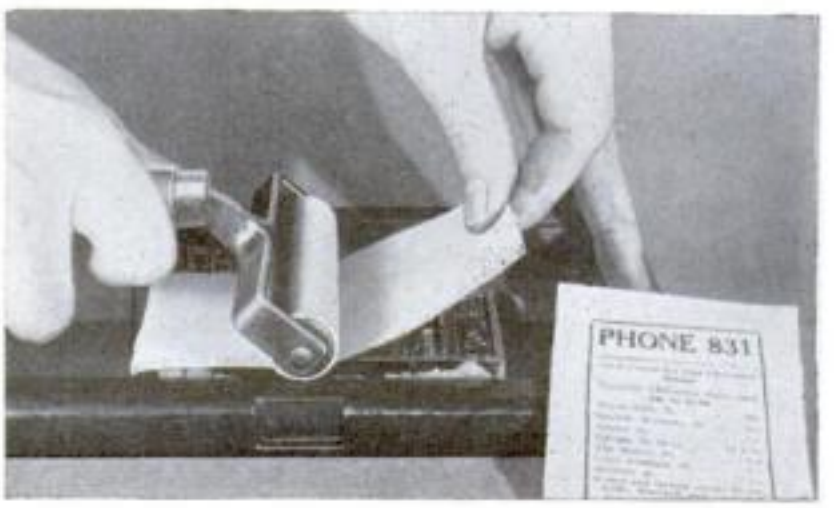
To give the well the appearance of being covered with moss, spatter the sides of the brickwork with cement colored by adding 5 cents' worth of dry ultramarine. After the well is completed, make a gravel path around it and leading up to it. The path may be edged with bricks.—J. P. KNIPP.



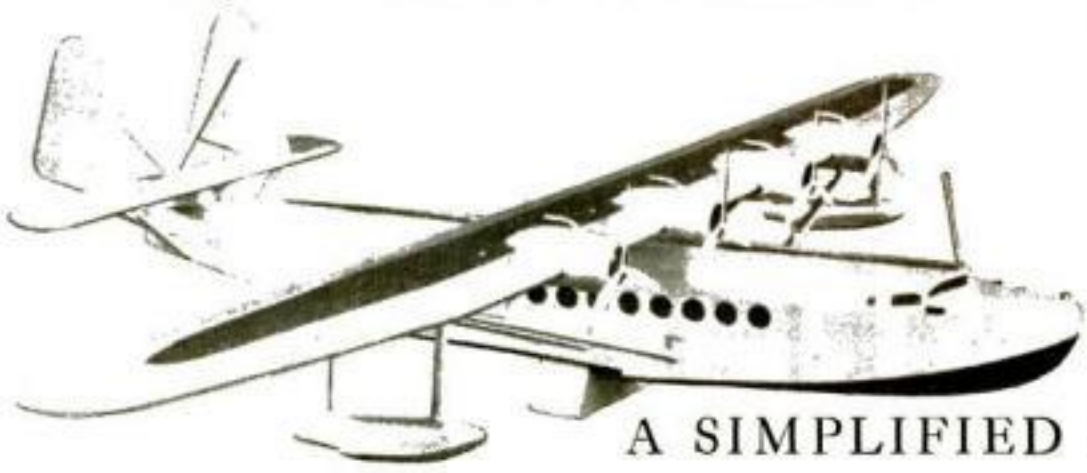
PROOFS PULLED WITH PHOTO ROLLER

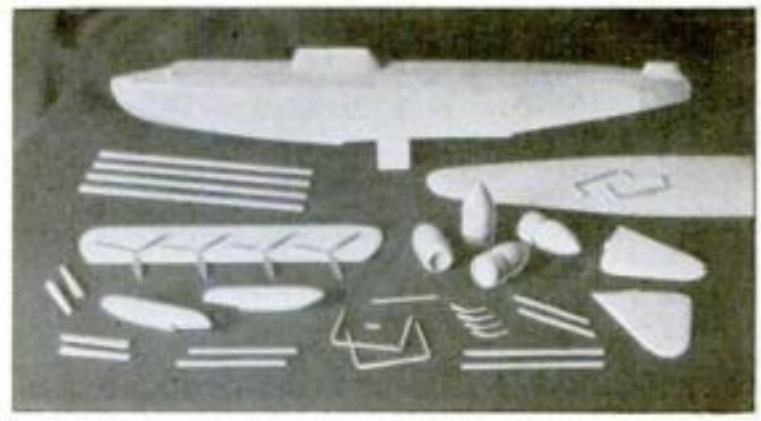
PROOFS of small jobs or set-ups can be pulled in a printing office or school printshop to be read for corrections by using an ordinary photo-print roller. The type is inked up with an ink roller in the usual manner; a sheet of paper is laid over it, and the photo print roller is pushed across with a little pressure. This method does not break down the fine lines in small type as is likely to happen with the planer and mallet method.

Where a dozen or two impressions of one set-up are wanted and the margins do not have to be accurate, the use of a photo-print roller will be found quicker than locking the job up and making it ready on the printing press. Amateurs who have a small printing outfit will find this kink helpful.—J. H.



By DONALD W. CLARK





A SIMPLIFIED SCALE MODEL OF THE

Largest American Flying Boat

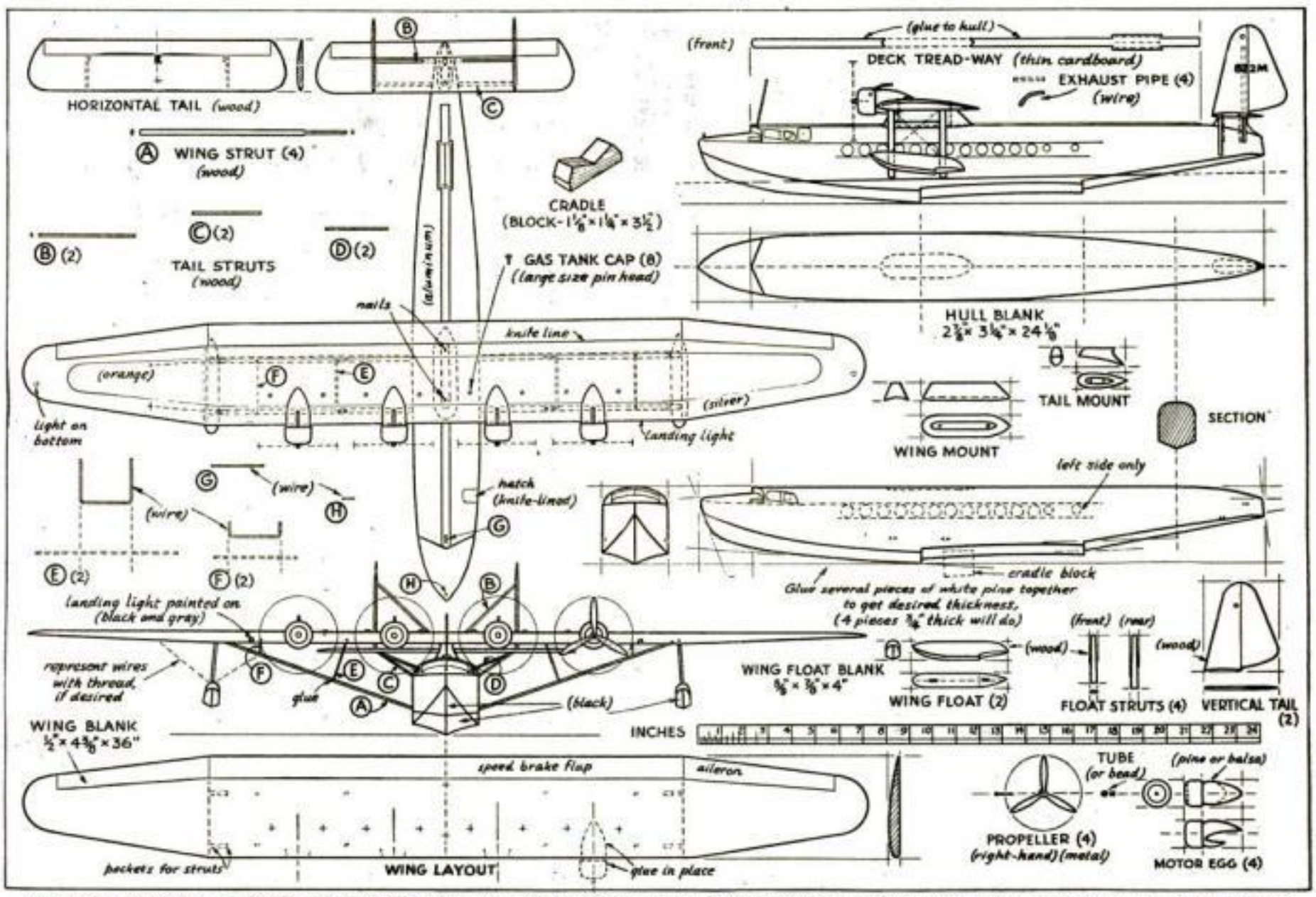
. . . *The New Sikorsky Clipper Ship*

HERE is the largest, most modern, and by far the most impressive model in our long series of solid scale model airplanes—the new Sikorsky S-42 flying boat. Large as it is, the scale of the model has been slightly reduced from that regularly used throughout this series. It is on the scale of 5/16 in. equals 1 ft. instead of 3/8 in. equals 1 ft. Those who are building a number of models in the series will find, however, that the Sikorsky model is so much larger than the others that the difference in scale will not be noticeable to even a well-trained eye.

The S-42 is credited with being able to fly 3,800 miles nonstop with thirty-two passengers, a crew of five, and 1,000 pounds of mail and express. Piloted by Col. Charles A. Lindbergh in a test with thirty-one on board, it made 190 air miles an hour. The span is 114 ft., length 76 ft., and weight 19 tons. Its engines develop 2,600 H.P. This great *Brazilian Clipper*, as it is called—its number is NC 822 M—already has broken two world's records. It is one of six ships ordered for the Pan-American Airways.

Because of its unusual size, the model is somewhat easier to build than some of the smaller designs that have appeared in the series. Only twenty-five main parts are required.

It will be neces- *(Continued on page 105)*



Assembly drawings and details of the hull, wing, and all important parts. A photo at the top of the page shows the parts ready to go together

Laying Out a Workshop

IN LIMITED SPACE

EVEN if you have only a small corner about 4 by 6 ft. in a spare room, screened porch, woodshed, cellar, or attic, you can lay out a satisfactory workshop with machines of the smaller sizes. A porch, if available, can be inclosed with wood wainscoting and glass windows obtained from a wrecking yard. It can then be comfortably heated with a so-called "hot-air" stove, which burns paper, shavings, odds and ends of wood, or coal. A new one can be bought for less than $2. Only as a last resort should an attic be used for your shop.

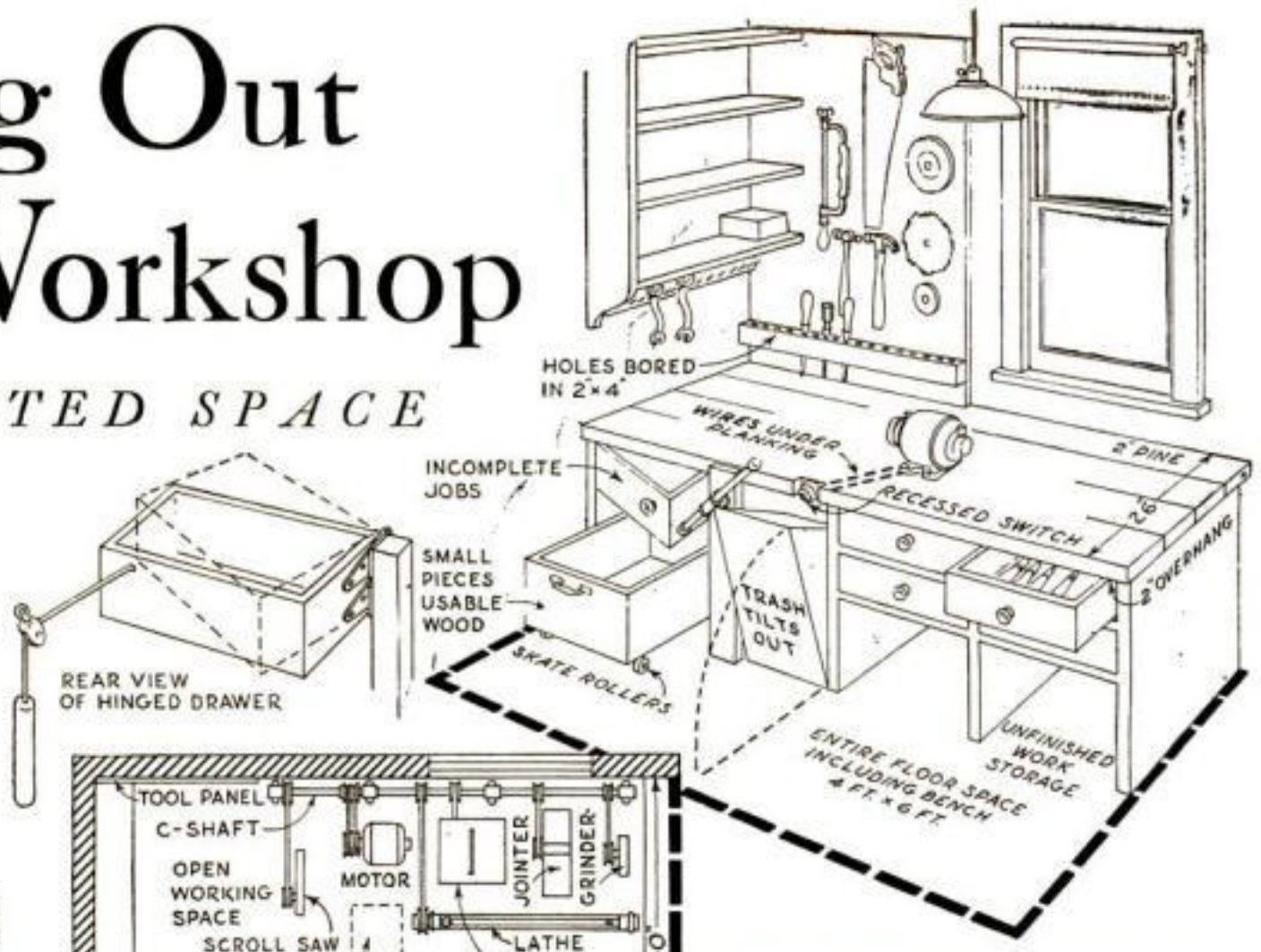
The accompanying plan shows the arrangement of one of the popular complete workshop outfits having one motor and countershaft—a small, moderately priced outfit. All the units can be arranged in a compact space. The bench should be about 34 in. high, or whatever measurement suits the height of the user.

In another drawing is shown the arrangement of shelves and drawers, and a tool panel on the wall. Small parts are kept in glass jars, heavier ones in boxes. In the ten-cent stores a handy three-compartment box can be purchased and labeled on the end, or one of the parts kept in each compartment can be wired on the outside instead of a label.

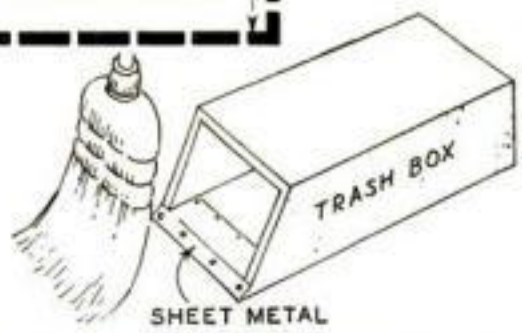
A swinging drawer, installed as shown, has been found a great convenience. Below this drawer is a large box on skate rollers that can be pulled out easily, giving access to a stock of short pieces of wood.

The tilting trash box illustrated is another handy accessory, because it can be laid flat on the floor like a huge dust pan and the shop litter swept into it over the lip.—HI SIBLEY.

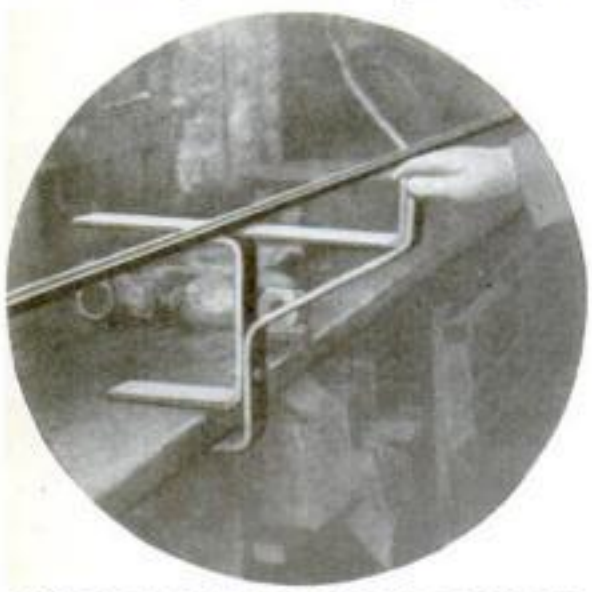
This is the second of a series of articles on how to lay out workshops.



Bench with space for small motorized home workshop outfit in which the separate units are driven by one motor and a countershaft



Plan of a 4 by 6 ft. shop designed to take a standard small outfit of woodworking machines with a drill press added. Details are given of a hinged drawer and trash box



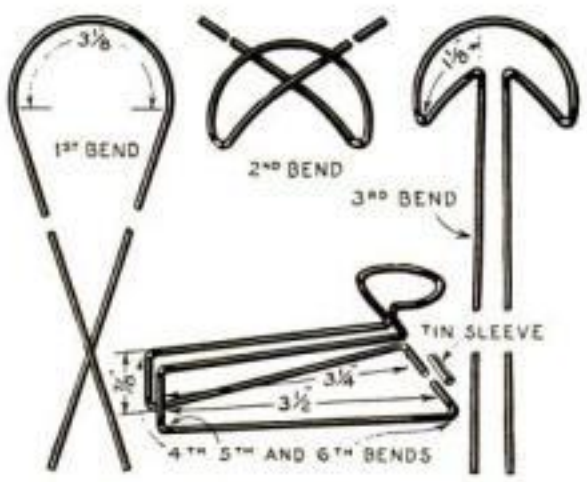
SUPPORT FOR LONG RODS

WHEN working on long material that is being held in a machinist's bench vise, it is necessary to have one or more supports for the ends. An especially serviceable type of support is illustrated. It is made from three sections of 2 by ¼ in. steel, bent as shown and riveted together in three places. This particular support is 16 in. wide.—JOSEPH C. COYLE.

TABLE PIPE RACK BENT FROM WIRE

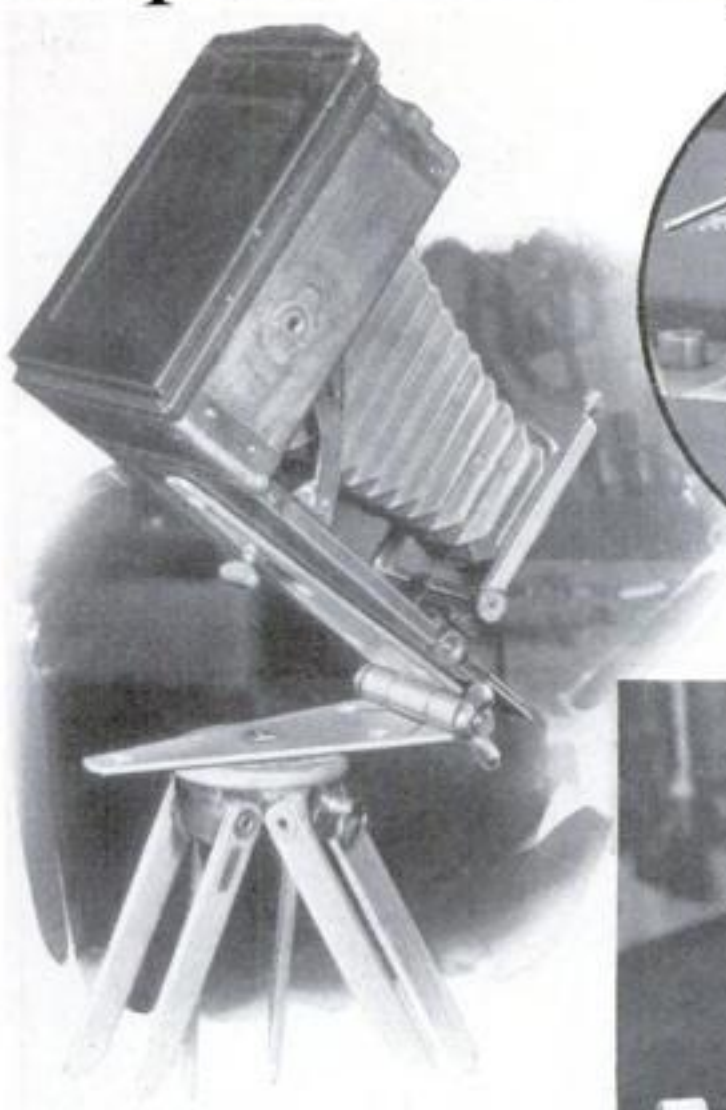
THIS wire pipe rack will prevent the spilling of ashes on your desk or table when you lay your pipe down temporarily, and it also provides a holder for the pipe when not in use. All that you will need are a pair of small pliers, a 24-in. length of wire, and a small piece of tin. The drawings show how to do the bending.

After the desired shape has been obtained, cut a piece of tin 1 in. long and wide enough to go around the wire. Make a sleeve of this by bending it around a straight piece of the wire. Then slip it over the two ends as shown. The ends may be soldered together if preferred. When completed, finish with brushing lacquer of any desired color.—D. H.

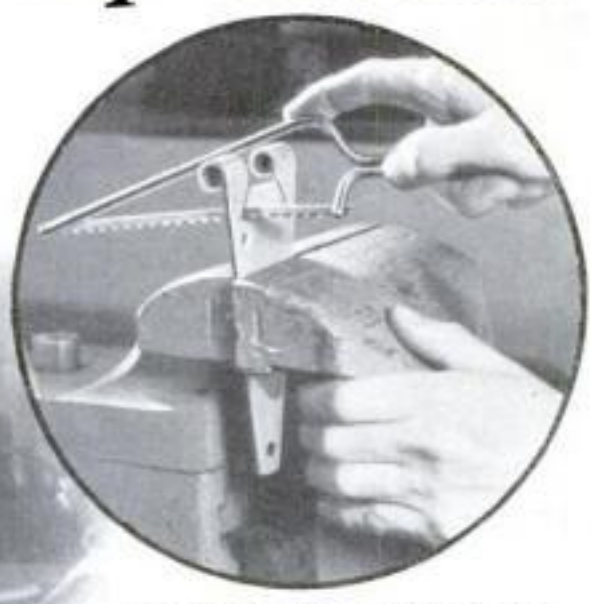


The rack keeps a pipe from spilling ashes on table when laid down. Sketches above show the steps in bending the wire to form the rack

Tripod *Tilt-Top* MADE FROM STRAP HINGE



Although made from a ten-cent hinge, this tilt-top is rigid enough for most cameras



Sawing slots in one of the leaves so the hinge joint can be locked

A nut is inserted into a square hole in the hinge and held by punching down the metal

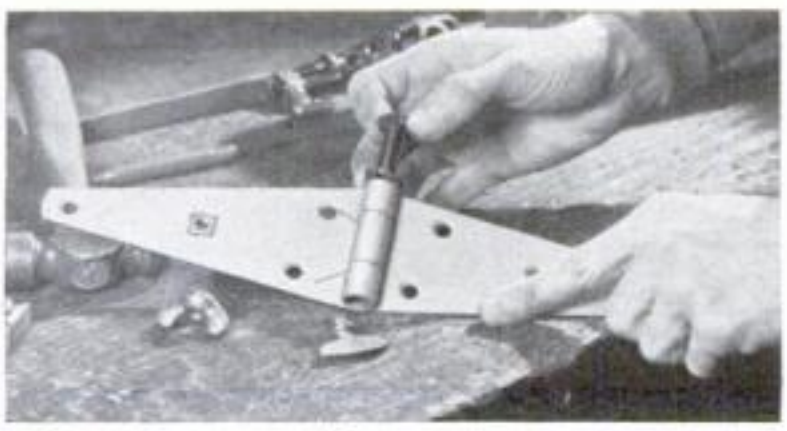
A SERVICEABLE tilting top for camera tripods can be made at a cost of a few cents from a large strap hinge such as those sold for use on barn doors. When the device is used between camera and tripod, the camera can be tilted at any angle for photographing objects on a table top, copying pictures, photographing insects, and the like. By reversing the camera so that the lens points in the direction of the open part of the hinge, pictures can be taken of tall buildings, clouds, and other objects in high positions.

Remove the pin from the hinge by filing or grinding one end until it can be driven out with a punch. Place in a vise the half of the hinge that has two turned-over projections, and make hack-saw cuts as shown in the photographs. This is to make it possible to force the two projecting parts slightly toward each other. Reassemble the hinge, using a machine bolt the same size as the pin that was removed, and a wing nut that can be turned easily with the fingers. Place a lock washer under the bolt head to prevent it from turning. By tightening the wing nut, you can lock the hinge joint.

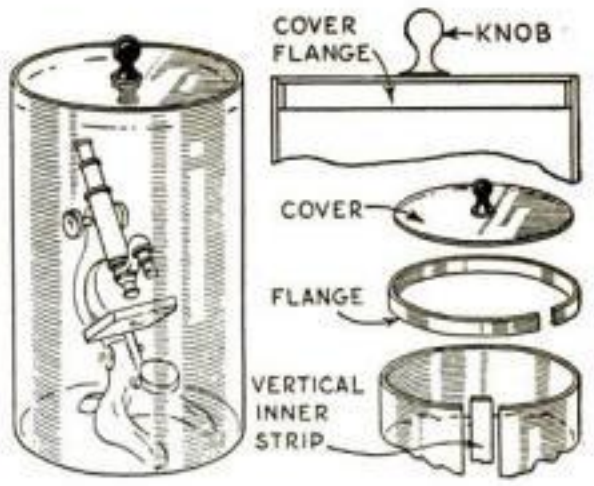
Most cameras have tripod sockets that take a ¼-in. bolt having 20 threads per inch, and therefore standard tripods are fitted with a screw of that size. For attaching the hinge to the top of the tripod, fasten a ¼/20 nut over a hole in the center of one of the leaves. You can solder this nut directly over a drilled hole; or make a square opening with file and chisel, insert the nut, and fasten it securely by using a punch to spread the metal near the junction lines.

In the other leaf of the hinge, drill a hole at a point where it will engage the camera tripod socket when the camera is held so that its bed does not interfere with the operation of the wing nut. A short ¼/20 bolt with a knurled or winged head passes through this hole into the camera socket.

If desired, the projecting ends of the leaves can be cut off to shorten the device.—W. E. B.



The two members of the hinge are fastened against slipping by means of a bolt, wing nut, and lock washer



PROTECTING MICROSCOPE

A LIGHTWEIGHT, unbreakable, and transparent cover for your microscope can be made from sheet celluloid, celluloid cement, and a small knob. The drawing shows how the cover is assembled. Small cuttings of celluloid dissolved in acetone or amyl acetate form a good celluloid cement. Glacial acetic acid can also be used alone as a glue, but you will find it rather messy, and the fumes are disagreeable. Small C-clamps will hold the material together while the cement dries.

AFTER you have installed a new wheel in a grinder, be sure to keep clear of its path the first time it is started up.

* * *

Always demagnetize work done on a magnetic chuck so it will not pick up grit.

* * *

A good place to keep your scriber, dividers, and other needle-pointed tools is fastened to the inside of the lid of your tool kit. They are then not so likely to be run into the hand.

* * *

The safest way to obtain a wringing fit is to work down from a light press fit.

* * *

A short length of rubber hose slipped over a chisel will give a better grip.

* * *

The shorter the chisel, the easier it can be guided along the work.

* * *

Objects with irregular ends can be ground on an external grinder by sweating on steel blocks and centering them.

* * *

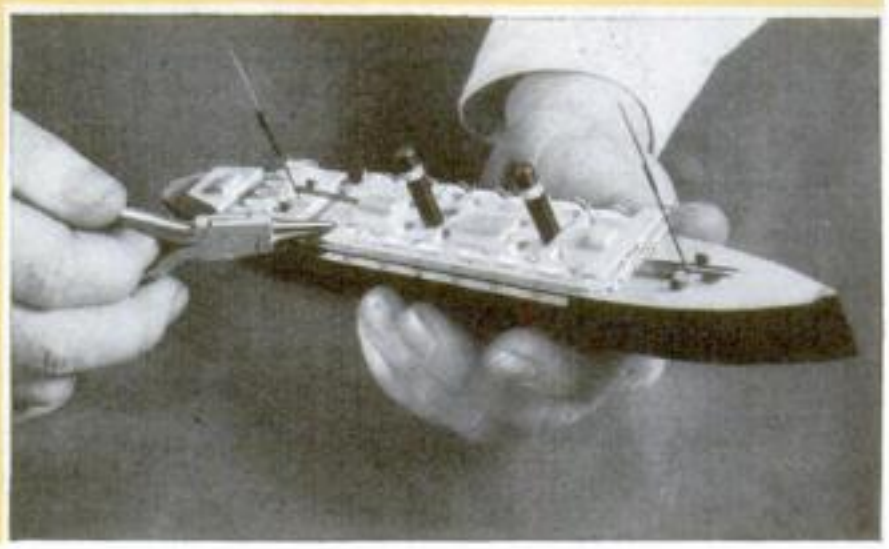
Be sure your "mikes" are all right, then go ahead.

* * *

A hollow fiber lap is best for the finishing touch.

MODEL of the MONTH No. 2

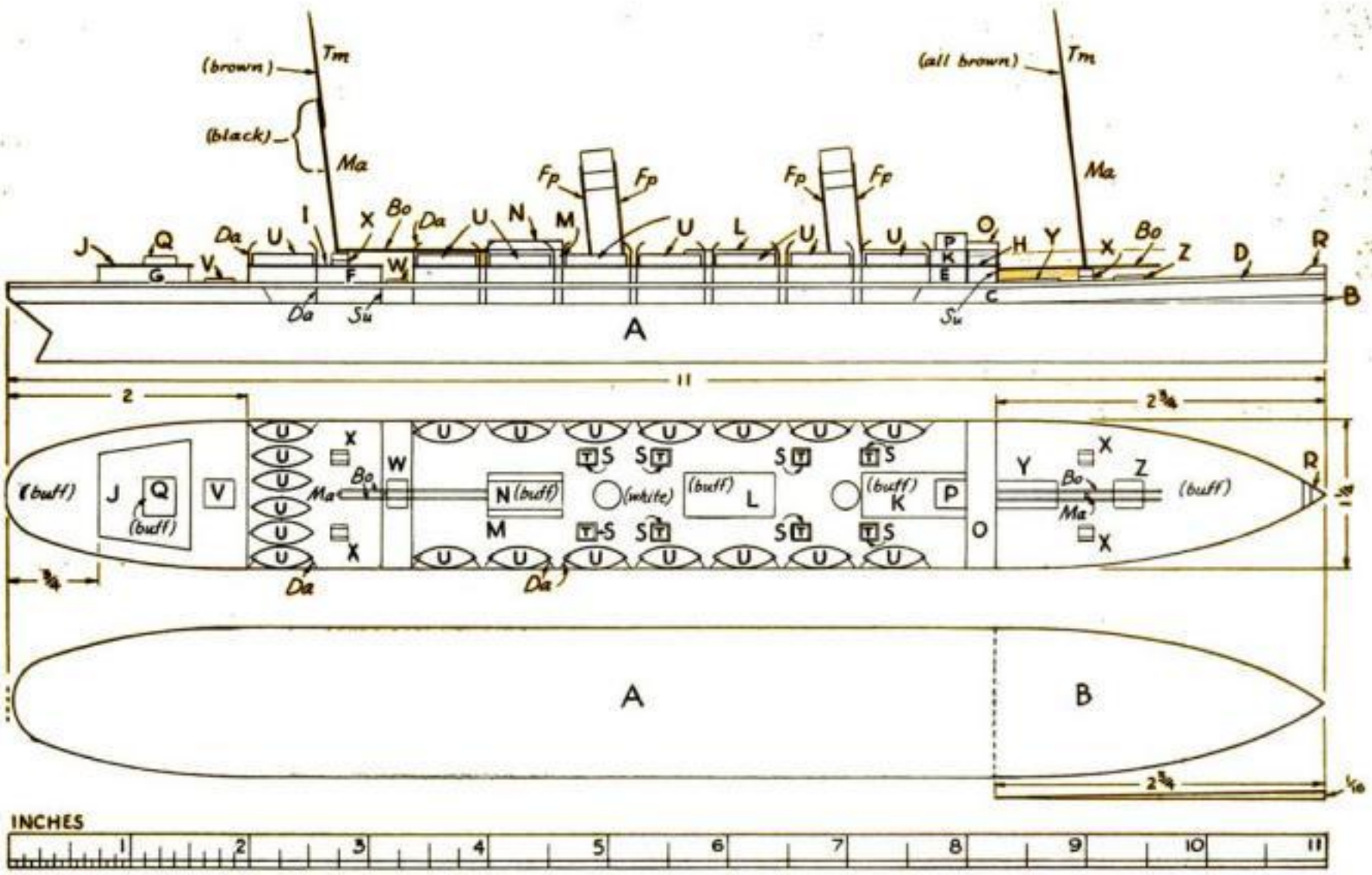
The Famous Old Liner ST. LOUIS



To make this beautiful little balsa-wood model of the steamship *St. Louis*, you need no tools but a pocketknife, a few razor blades, a pair of round-nose cutting pliers, a ruler, and some small brushes

FEW ships flying the Stars and Stripes have had more interesting histories than the *St. Louis* and her sister ship, the *St. Paul*. Built in 1894 to regain America's prestige on the Atlantic, they immediately captured the public's favor and kept it through twenty years of rapidly increasing competition. Twice called to serve the nation in war, they were used as auxiliary cruisers in 1898 and as transports in 1917. When finally towed away to be broken up in 1923, ship lovers everywhere realized that two of the most graceful steamships ever built were gone forever.

These vessels were also noteworthy from the engineering standpoint. When they were launched, there were only two ships afloat surpassing them in size and speed. Also, they were the first large ships to be fitted with quadruple ex-



Side and deck views of the model with all parts lettered, and a plan view of the main hull block *A* and the tapered piece *B* which is glued on it

A MINIATURE WATER-LINE SCALE MODEL DESIGNED BY

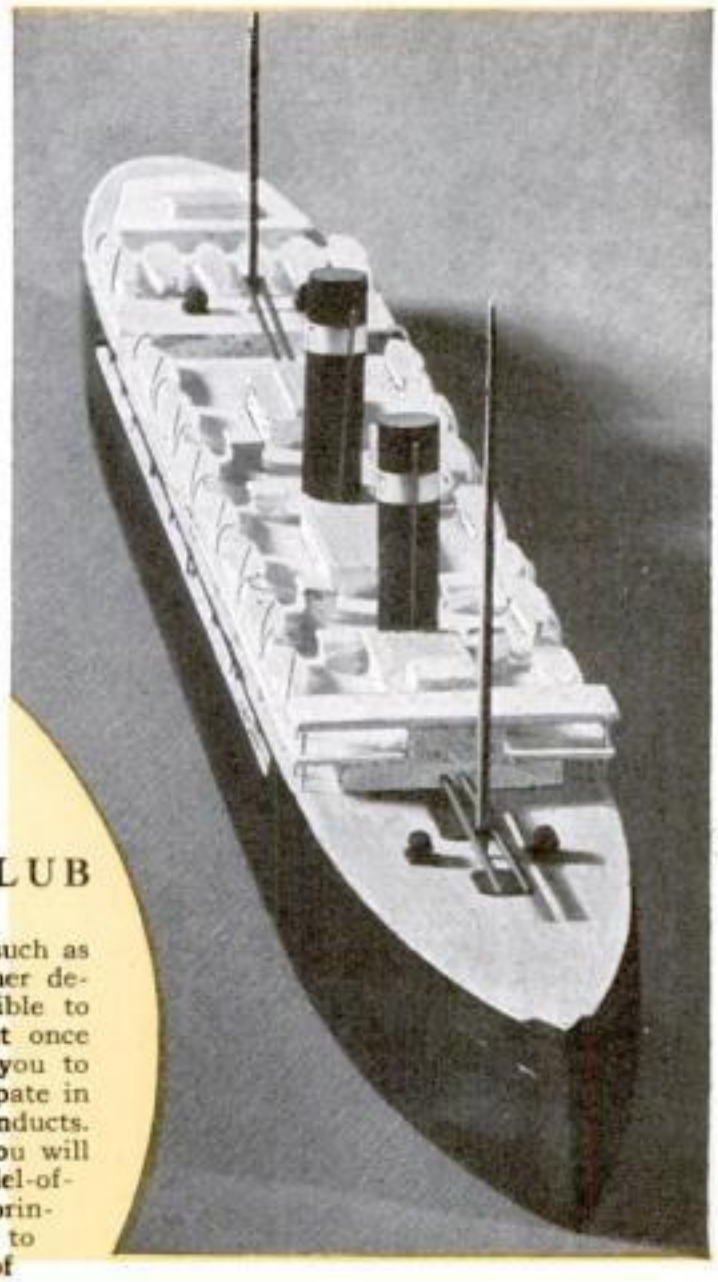
Theodore Gommi

pansion engines. The previous limit had been engines of triple expansion.

Their place in any history of American ships is one of prime importance, and we are therefore placing in our model-of-the-month series a model of the first of these two liners to be completed, the *St. Louis*.

The scale of the model is 1 in. equals 50 ft. The method of construction is similar to that of the previous models of this series (P.S.M., Aug. '34, p. 69) and therefore needs no detailed explanation. Begin by cutting all material to the sizes specified in the list of materials. Measure carefully because fully two thirds of the pieces are ready for use in the final assembly when cut to these specifications.

Cut pieces *A*, *B*, *C*, *D*, and *R* as shown in the drawings. *B* must be sandpapered so that it becomes gradually thinner, since it acts as a wedge to raise the deck at the bow. Glue *B* to *A*, *C* to *A* and *B*, *D* to *C*, and *R* to *D*. Sandpaper all around, making certain that the layers join evenly. Carve the stern to the usual shape of *(Continued on page 106)*

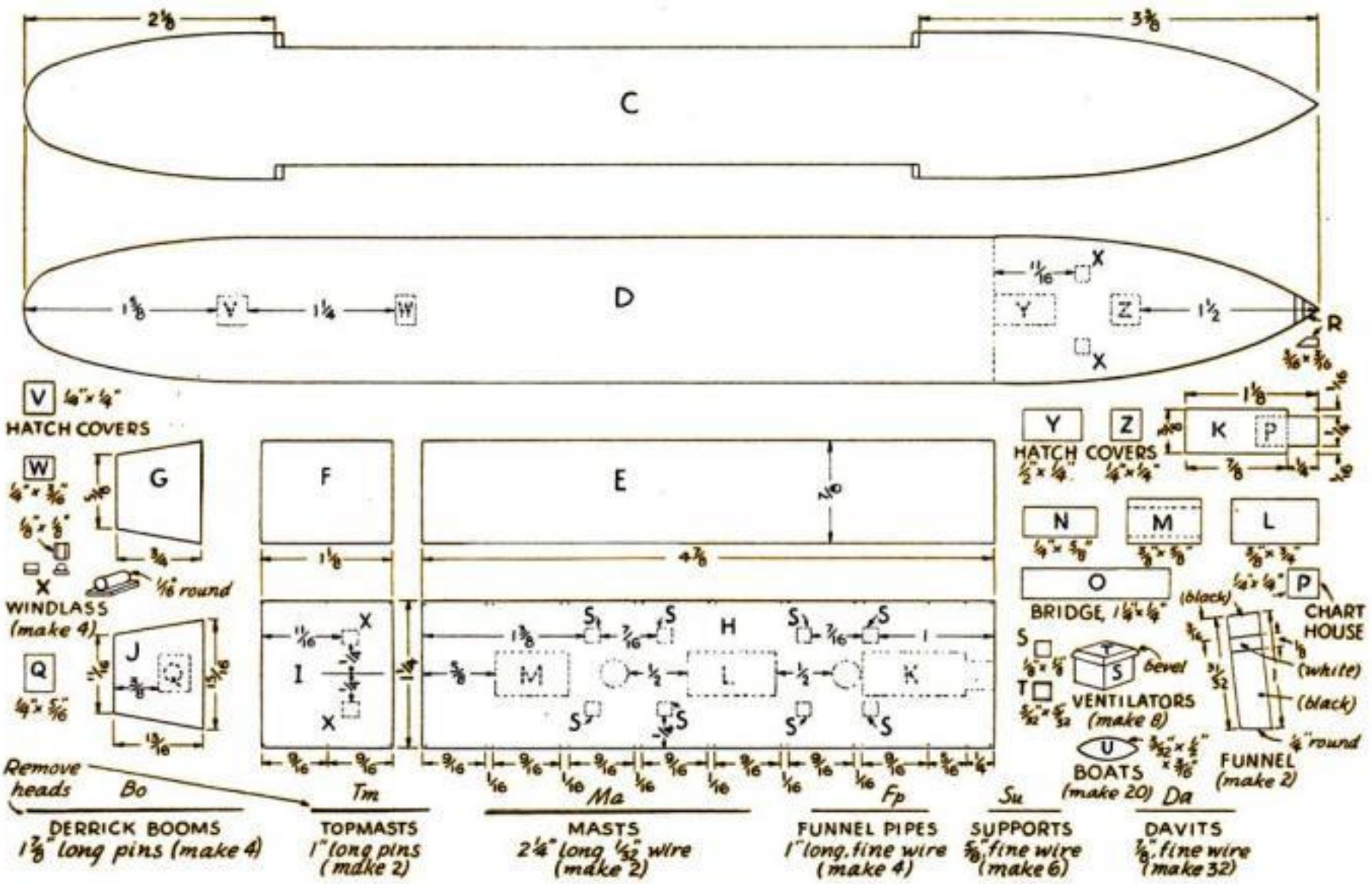


Realistic as it is, the model is made up of very simple units, which are painted beforehand so that no skill with a brush is needed

Here's Your Chance

TO JOIN OUR NEW MODEL-OF-THE-MONTH CLUB

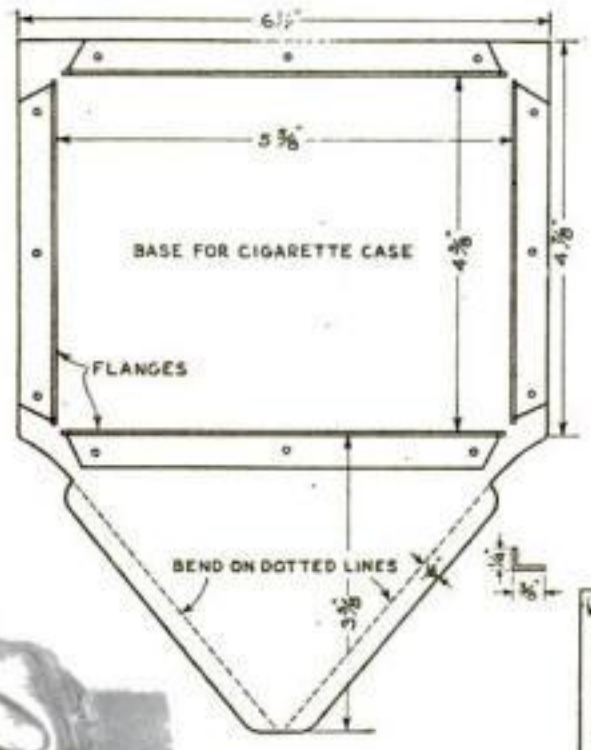
If you are interested in building miniature models such as the S. S. *St. Louis*, or the U. S. S. *Saratoga* and her destroyer convoy described last month, you are eligible to join our new Model-of-the-Month Club. Join it at once and receive a membership certificate that entitles you to all the benefits of the club and allows you to participate in any exhibitions, contests, and other activities it conducts. There are no dues and no obligations whatever. You will find a membership blank in every one of the Model-of-the-Month construction kits (see page 106). The principal object of the Model-of-the-Month Club is to present a complete series of miniature models of the most famous warships and commercial vessels in United States history.



The remaining parts drawn to the same scale as the views on the preceding page. A full-size blueprint is included in each construction kit

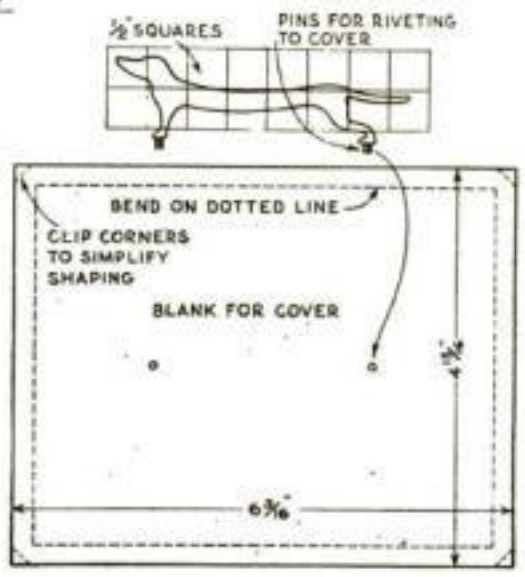
Snap-on Cover *for* Cigarette Tin

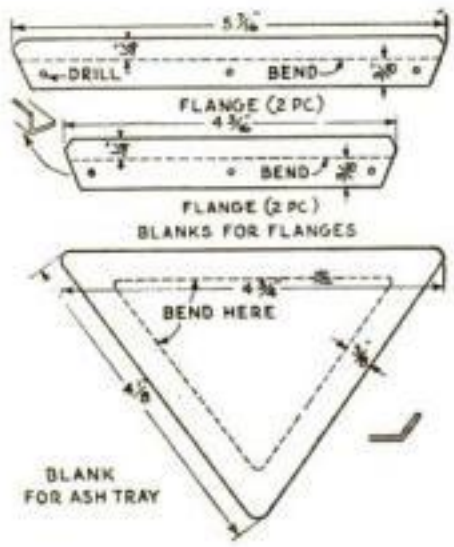
This is the complete smoking set consisting of a hammered copper cover that is sprung on over the lid of a standard fifty-size cigarette tin, a base for the tin, and a removable triangular ash tray



Pattern for making the base. It is 16-gage copper, hammered on one side. Four angles of the same metal are bent as shown and riveted to the base to serve as retaining flanges for the tin holding the cigarettes

The cover for the cigarette tin is cut to the dimensions given at the right. The edges are bent down ¼ in. all around over a steel block as at the left





CIGARETTES, when bought in tins of fifty to take advantage of the reduced price at which they are sold, can be dressed up to look more attractive by making a decorative copper cover to snap on over the tin. The idea can be carried still further, if desired, by making a complete smoking set which forms a case for the tin and, in addition, contains an ash tray.

The copper is of 16 gage, and should be annealed. This is done by heating the metal to a cherry red, then letting it cool gradually. Brass, of course, can be used instead of copper, but it is harder to work.

Cut out a piece 6 3/16 in. long by 4 15/16 in. wide, and hammer one side with the flat or planishing face of a ball-peen hammer. Lay the piece out with the hammered side down, and draw or scribe a line all around ¼ in. in from the edge; then lay the cigarette tin, cover down, on the piece inside of the lines to make sure that the lines are exactly right.

To shape the rim, place the piece, hammered side up, over any square-cornered steel or iron block so that the line comes exactly on the edge, and hammer the ¼-in. margin down over the edge of the block. Complete this all the way around, forming the corners around the corners of the block. The corners can be drawn in smooth and evenly if the copper is soft and the work is carefully handled.

Fit the finished cover over the cover of the tin of cigarettes, and drive the rim in slightly, if necessary, to make it fit snugly over the cover of the tin. Then finish the edges smoothly with a file.

The dachshund handle is cut from 10-gage sheet copper with a jeweler's saw, either by hand or on a power jig saw. A projecting pin should be left on the bottom of each foot for riveting in place on the cover. Finish the edges with a file, and file the two projecting pins round. Drill two corresponding holes in the cover. Set the dachshund in place and rivet the two pins on the inside of the cover.

Scrub the piece thoroughly with soap and water, removing all scale. Then color it with a solution made by dissolving a small piece of liver of sulphur in a quart of water. Leave the piece in this solution until it takes on a dark brown color, whereupon it can be removed, washed, polished, and lacquered.

Anyone who makes the cover will find it worth while to complete the set, for the rest of the work is very simple. The material used is the same gage and hammered on one side. The four strips that form the receptacle for the cigarette tin are bent in the vise, drilled, and riveted in place with escutcheon pins. The flanges that form the ash-tray rest, and the three cornered ash tray itself, are formed over the steel block, as was the cover. The cigarette tin should fit very snugly into its receptacle so that the cover can be raised easily without lifting out the box of cigarettes. The whole should be finished in the same manner as the cover. The dachshund design used as a handle on the cover is merely a suggestion. Any decorative silhouette that will serve the purpose may be used.—Dick Hutchinson.

KNEELING PADS MADE FROM INNER TUBE

For working in the garden or, indeed, any job that calls for kneeling, these rubber pads are convenient protectors

Rubber pads to protect the clothes while kneeling on the moist earth when working in the garden can easily be made from sections cut out of an old inner tube. After two pieces have been cut to the desired length, they are slit open along the back except at either end, where a band is left to hold the pad in place on the leg. These knee protectors are easily taken on and off, are very durable, and, unlike the ordinary kneeling pad, stay where you want them.—Emil Pearson.

Committee Studies Work of Home Workshop Clubs to Find Best Ways of Dividing the Many Large Cash Awards and Trophies in Coming Competition

GUILD PRIZE CONTEST

A meeting of the Scranton Craftsman Society at which Leo C. Radle, the member second from the left, gave a demonstration on wood turning

Official Magazine POPULAR SCIENCE MONTHLY

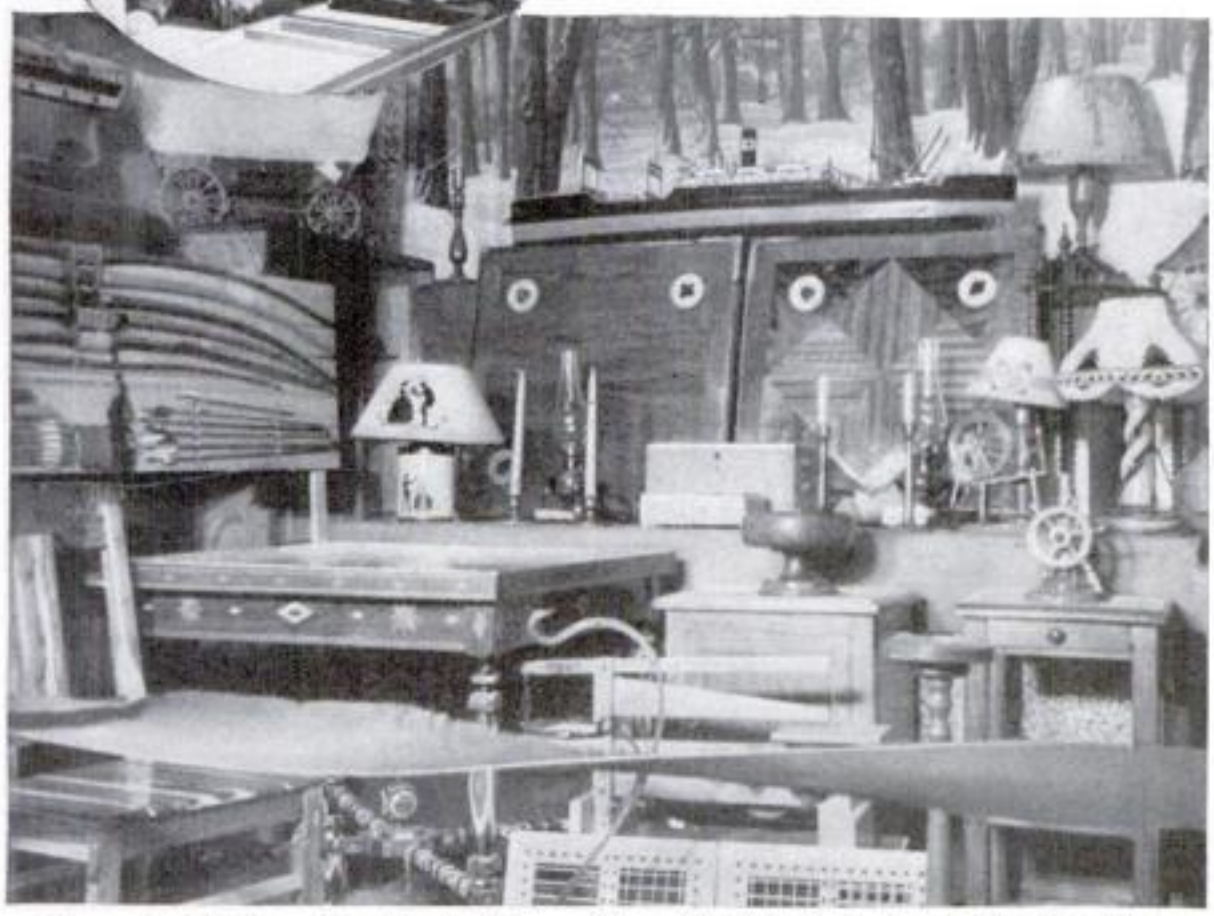
To Cover Most Popular Types of Craftwork

PLANS for the great nation-wide contest of the National Homeworkshop Guild are rapidly being whipped into shape. Following the announcement in POPULAR SCIENCE MONTHLY last month, the first step of the Contest Committee was to determine from the records of the affiliated clubs what classification of prize awards would have the widest appeal.

It was found that woodworking was the subject of outstanding interest among all clubs. Arrangements will therefore be made to allocate the largest number of cash prizes and trophies for various branches of woodworking—furniture, novelties, wood turning, veneering and inlaying, toys, and similar projects.

The classification next in importance is model making. While ship models lead in this division, a surprising number of club members were found to be building airplane models, locomotive models, and miscellaneous models of various types.

Decorative metal working, miscellaneous craftwork, tool and machine building and other home workshop classifications are also being considered, and prizes will be provided for those in which a sufficient number of entries can be assured to make the competition *(Continued on page 96)*



Corner of exhibition of the Topeka Homeworkshop Club held in the Central Market. There were 155 exhibits covering various types of craftwork. *In circle:* Steve Smith (right) and C. W. Shadwick, Jr., who gave a demonstration on photomicrography before the Topeka Club

If well made, this spinach cleaner, once put in motion, will continue to turn by the force of the water alone

RAPID SPINACH CLEANER

A TIMESAVING device for removing sand or grit from spinach and related greens can be made from a little wire, an iron rod, and a few pieces of wood from old boxes. These are put together in the form of a wire cylinder with a small door to admit the greens. The iron rod serves as the axle. It passes through the circular end pieces of wood and is bent to form the handle.

Water is played upon the cylinder while it is being turned, and the centrifugal motion removes all grit.—F. G. TAIT.

FASTENING FRAMES TO DISPLAY CARDS

CARDBOARD and wall-board signs, cut-outs, and window displays large enough to require a wooden framework for support, may be attached to the frame without the use of nails, fasteners, or staples, which mar the exterior surface and detract from the neatness of the display.

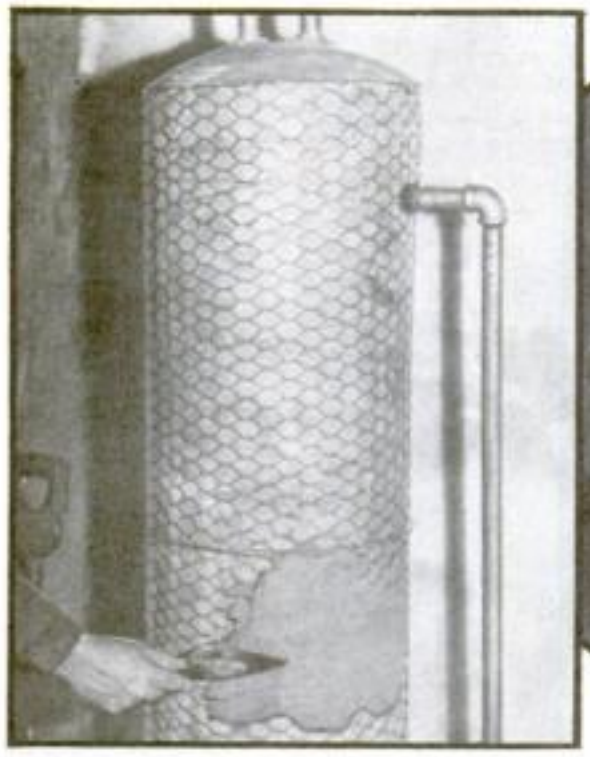
First cut the framework to fit and fasten the pieces with corrugated fasteners or nails. Lay the frame against the cardboard in the desired position and outline it with pencil. Remove the frame and apply a good grade glue, cellulose household cement, or liquid solder to the surface within the pencil lines and to the surface of the frame that is to fit against the cardboard. Allow the adhesive to dry; then apply a second coat very liberally.

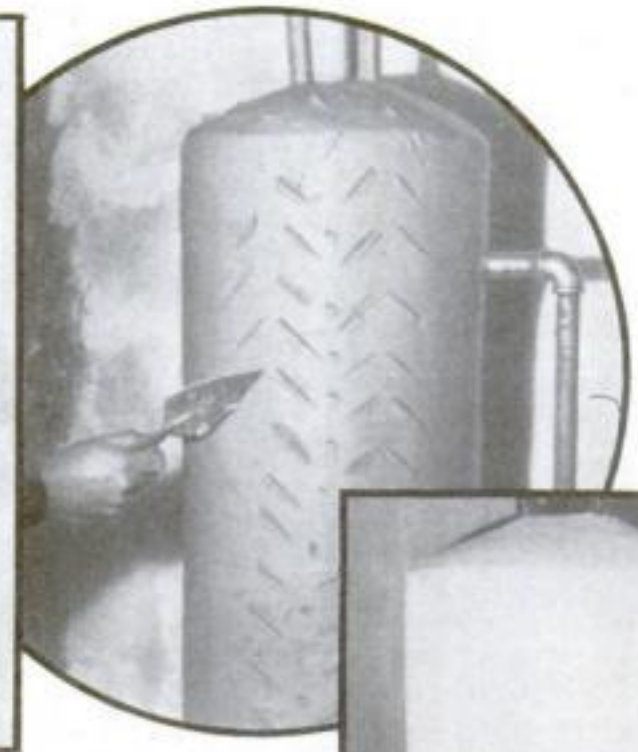
Lay the cut-out face down, place the framework on it to correspond with the pencil marks, and set heavy weights on all parts of the frame. Allow this to dry.—JESS JONES.

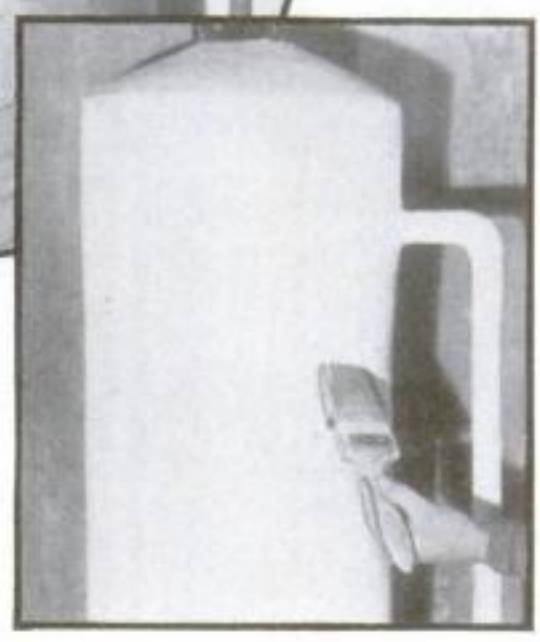
Wooden strips, glued on with the aid of weights, strengthen large cardboard posters such as clubs, schools, theaters, and stores use for advertisements

Theatrical cut-out with strips glued on the back. With this method, no unsightly tacks or staples are seen from the front

Fuel Saved by Insulating Hot Water Tank with Asbestos







After the chicken wire is applied, asbestos cement is troweled on and roughened to hold the following coat

More asbestos is added to give a thickness of about ¾ in. The last coat is calcimined

MANY hot water tanks, especially in older houses, have no covering and therefore radiate heat unnecessarily. In the course of time they cause a considerable amount of fuel to be wasted, and if a gas heater is used, as is ordinarily the case, this makes the monthly bill higher. By covering the tank with asbestos cement, more hot water of a higher temperature will be available and less fuel consumed.

About 50 lb. of asbestos cement are required, together with sufficient 1-in. mesh chicken wire to wrap completely around the tank and about 40 ft. of No. 18 copper wire. Wrap the wire mesh around the tank as tightly as possible. Fasten one end of the copper wire to the tank piping where it enters at the top, and bind on the mesh firmly. Twist the ends of copper wire together at the bottom after making several turns in one place. The chicken wire, although drawn up as tightly as possible, will be found to be from ⅛ to ¼ in. from the surface of the tank in many places. This is as it should be, for its function is to serve as wire lath for the cement.

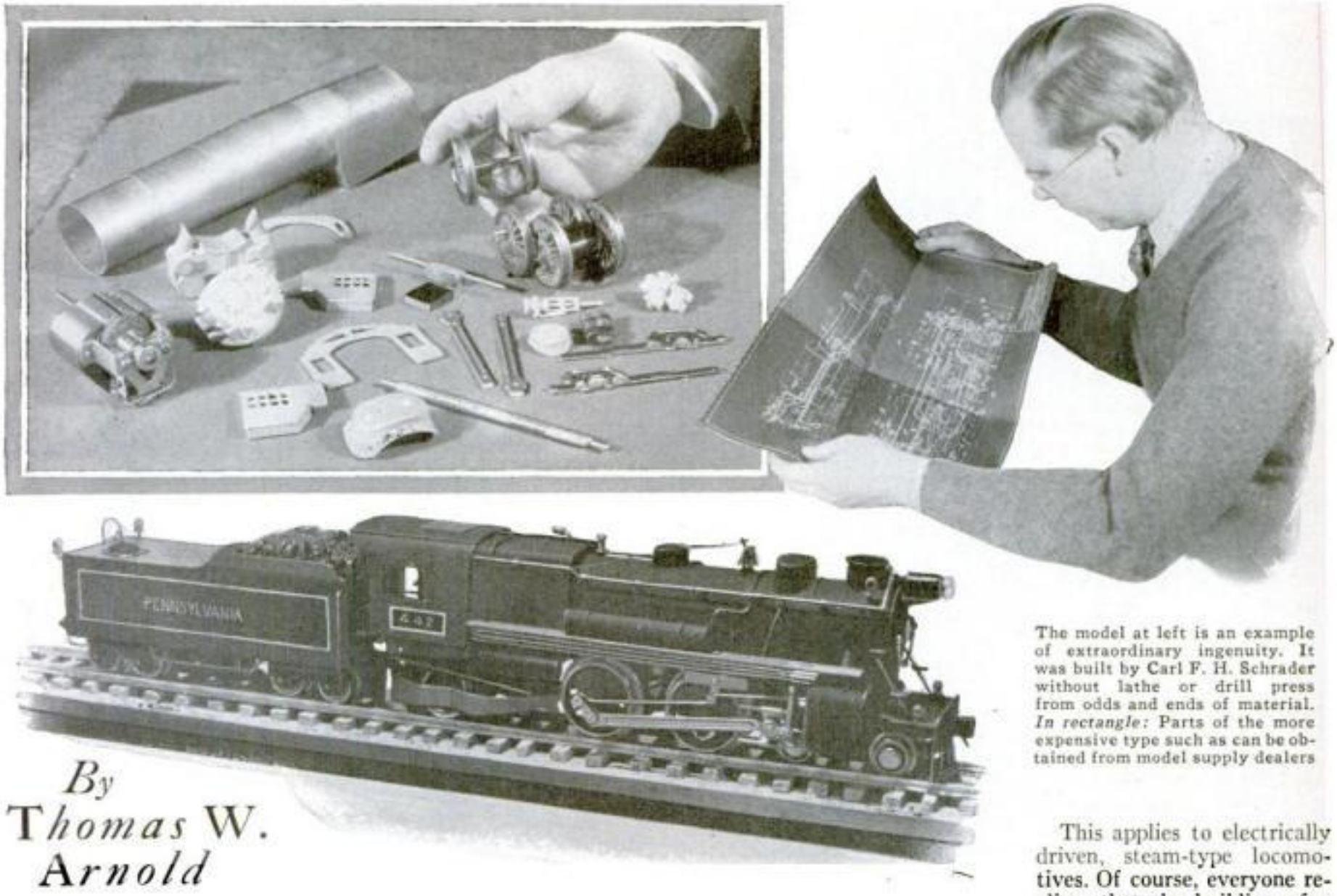
Mix the cement with water to the consistency of soft dough, a bucket at a time. There should be no free water visible in the mixture. Using a mason's 4-in. trowel—a cheap one can be bought for 10 cents—spread one coat all over the tank of sufficient thickness to conceal the wire mesh. The work preferably should be done when the tank is warm so the cement will harden overnight, otherwise a week or so will be required. Roughly smooth the surface with vertical strokes of the trowel, and make herring-bone marks as shown in one of the photographs. This will form a tooth to key the next coat in place.

Three coats will produce a covering about ¾ in. thick. The final, or fourth, coat should be carefully smoothed, preferably with a molder's slick, and allowed to harden.

The natural color of the cement is a greenish gray, but a brushing or two of calcimine will produce the conventional white finish.

If there is much bare piping immediately adjacent to the tank, it should be covered with regular steam-pipe insulation. Short lengths, however, may be readily coated with cement by squeezing it around the pipe with the hands until it clings.—EVERETT EAMES.

"SHALL I BUILD A Model Locomotive?"



The model at left is an example of extraordinary ingenuity. It was built by Carl F. H. Schrader without lathe or drill press from odds and ends of material. *In rectangle:* Parts of the more expensive type such as can be obtained from model supply dealers

By Thomas W. Arnold

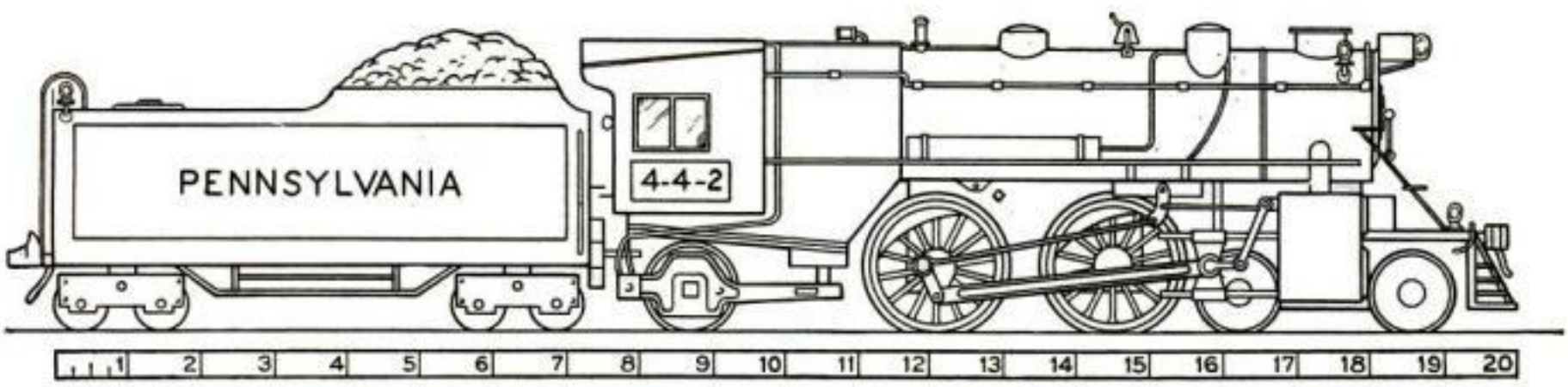
MANY a model railway enthusiast has asked himself such questions as: Shall I try to build a model locomotive? Where can I get plans for one? How much will it cost? How long will it take? These questions often appear in letters to the Home Workshop Department, usually coupled with a request for a constructional article.

To these questions there are nearly as many answers as Solomon had wives. Dealers in model railway supplies have plans of innumerable types and sell a great variety of castings, semifinished and finished parts, construction sets and fittings. The difficulty is to know what to choose from this great assortment.

One important point should be understood before you tackle building a model locomotive. There is an essential difference between a model locomotive and other non-operating models such as a model galleon, for instance. The latter, no matter how elaborate, is only something to look at—an ornament. External details are all-important. A model locomotive, on the other hand, is a piece of machinery in which mechanical running qualities are just as important as external detail. For that reason the blueprints of a model locomotive are much more complicated and difficult to read than those for the most pretentious ship model. Building a model locomotive likewise requires considerably more mechanical knowledge.

This applies to electrically driven, steam-type locomotives. Of course, everyone realizes that the building of a real steam-driven scale model locomotive from rough castings and bar and sheet metal is a task that calls for a high degree of mechanical skill and either elaborate shop equipment or an amazing amount of ingenuity in making inadequate equipment serve the purpose.

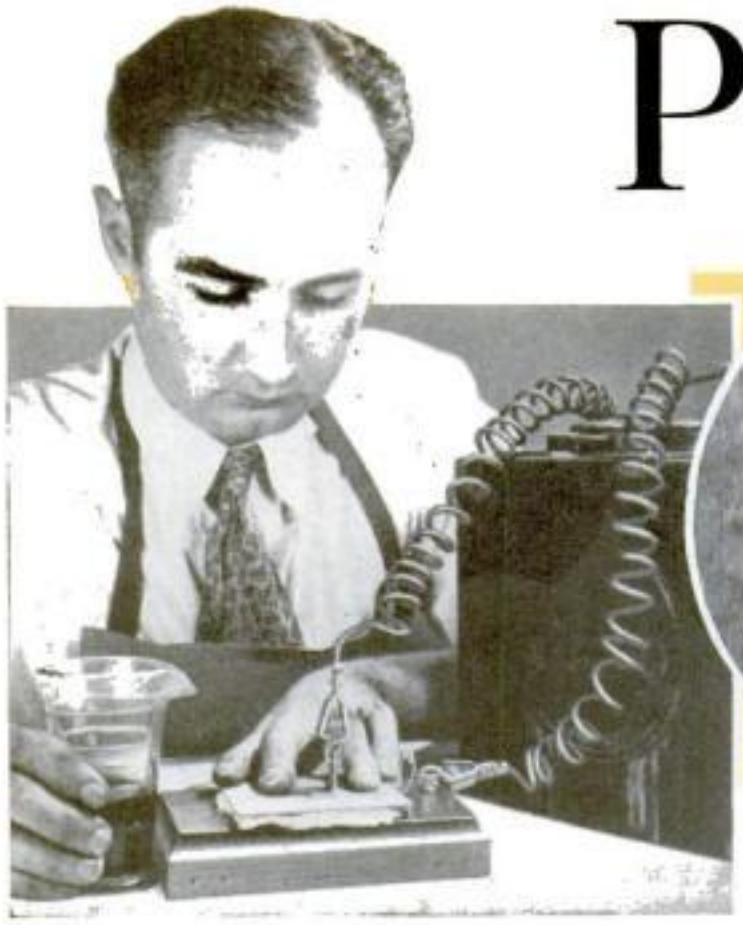
All sorts of compromises are possible. If you haven't the ability or equipment to make parts of the running gear, yet you feel that you could fit them together, once made, and also do the external work that adds so much to a realistic appearance, the answer is to buy what you can't make and do the rest yourself. A photograph at the beginning of this article shows just a few of the hundreds of small parts different makers can *(Continued on page 99)*



This is the drawing Mr. Schrader prepared before building the spring-motored "O" gage locomotive shown in one of the photographs above. A model maker, if reasonably familiar with locomotive construction, can prepare such drawings accurately enough from photos of an engine

Plating Metal

By
Kenneth Murray



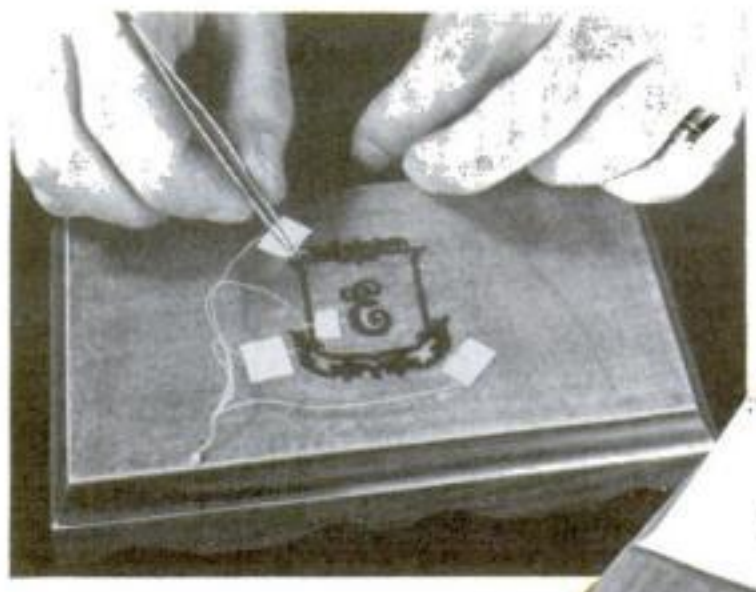
Small designs can be plated by means of two or three ordinary dry cells, but when considerable metal must be deposited, it is better to use a storage battery

INITIALS, designs, or lettering may be plated with any metal on the lid of this novel wooden cigarette container. Although a cigarette box has been chosen as an example, metal-plated designs can be easily applied to any other object by the same method, no matter of what material or composition it happens to be made.

Once you have learned how easy it is to apply decorations of this type, you will see opportunities to use them to ornament many different novelties and gifts. Almost any article you intend to present to another person will be more highly appreciated if it carries an initial or monogram, which can be applied by this plating method in such a way as to enhance the value of the gift considerably.

If you wish to practice the method by constructing a cigarette box like the one illustrated, it will be necessary first to make the box itself. The design is an unusual one in respect to the joint between the lid and the box proper. Indeed, the lid fits so well that the box will keep cigarettes fresh for a much longer time than ordinary containers.

The box in this instance was made of five-ply wood, the parts as follows: Top, 6¼ by 3¾ in., beveled at 15 deg.; 2 sides, each 3 by 4 in.; front and back pieces, each 3 by 6½ in.; bottom, 3¼ by 5¾ in., or an inside fit, according to the thickness of the plywood. First miter the ends of the sides, front, and back at 45 deg. This can be done more accurately by tilting the saw table than by using the jointer. To provide the lid, the pieces are then cut apart on the scroll saw with a fine jig-saw blade. Make the cut 2⅛ in. from the bottom in a straight cut for the back, where the hinges are to be fastened, and with the table tilted to 15 deg. for the sides and front. For the latter three, cut a sheet of paper to the width of the pieces and fold it twice; this may then be cut on a curve so that, unfolded, it forms a template for a design like that illustrated. The bevel cut



When the decoration has been treated with plumbago, fine copper wires are connected to it with adhesive tape

The joint of the lid at the back, where the hinges are, is straight, but the remainder of the joint is scalloped and slightly beveled so as to fit well

The surface is treated with egg white and the design transferred to it by means of carbon paper

is important because it makes the completed cigarette box practically air-tight.

After gluing the parts together, give them a coat of shellac, sand down, and coat the top with varnish. When the varnish is completely dry, coat the top with a solution made from the white of an egg thoroughly mixed with an equal quantity of water. On this surface the design to be metal-plated is traced with the aid of a piece of carbon paper. Remove the paper and carefully go over the design with shellac applied with a narrow, pointed brush. Quick-drying varnish may also be used.

In order to metal-plate the shellacked design, it is next well covered with powdered plumbago (graphite) while still tacky. An alternative method, when there are no fine lines in the design, is to use fine bronze powder. As the surplus of the latter can be brushed off readily from the background, the coat of egg-white solution is not needed. In using plumbago, the excess can be removed from the background with a piece of wet cotton. This loosens the coat of egg albumen and takes with it the plumbago where it does not form a part of the design. Remove this surplus carefully.

By means of small pieces of adhesive tape, fine copper wires are placed in contact with all parts of the design and then connected to the negative pole of a storage battery, or two or three dry batteries. While the latter will serve for small designs, those requiring the deposition of considerable metal can be plated better by the use of a storage battery because of its greater amperage. A layer of cotton is placed over the design and soaked with a plating solution. On top of this put a sheet of the metal to be plated, connected with the positive pole of the battery.

Plating solutions have already been described in articles on the subject which have appeared in this magazine. Inasmuch as copper is a satisfactory metal for the

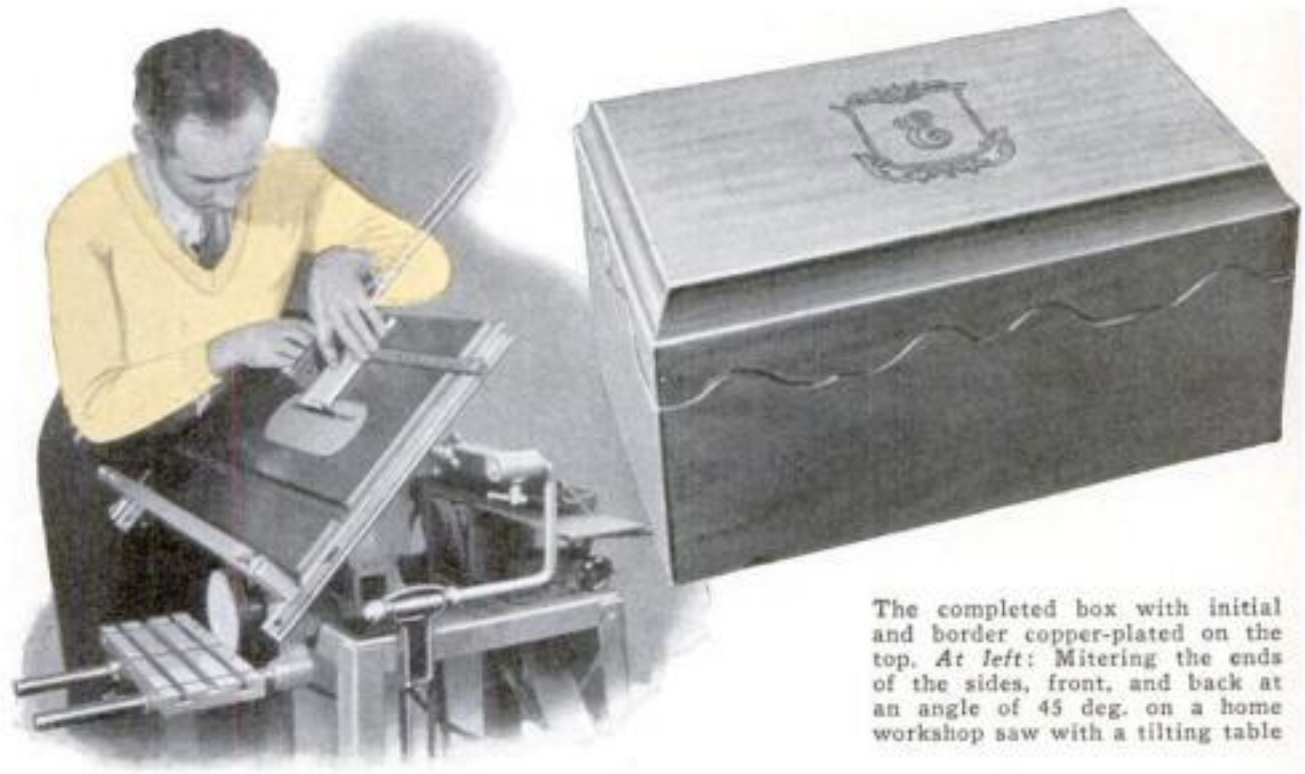
on Wood

A SIMPLE WAY TO DECORATE BOXES AND OTHER CRAFTWORK NOVELTIES

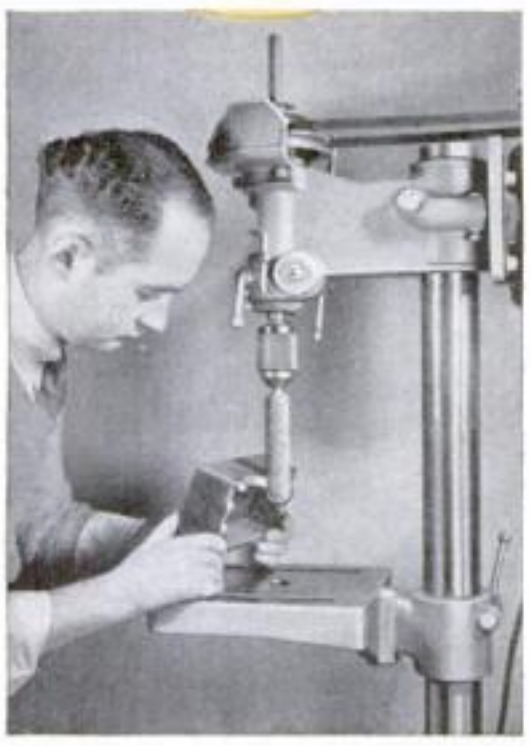
purpose, giving the appearance of yellow gold, a simple solution of copper sulphate to which has been added several drops of sulphuric acid is recommended.

The length of time required for plating depends on the thickness desired; when a storage battery is used, a half hour is generally sufficient. Then remove the cotton and all connecting wires, wash off all the solution, and dry carefully. The design can be buffed if desired.

Give the entire box a coat of varnish and then polish it with a paste made with oil and rottenstone or very fine pumice. A good way to apply this is by means of the drill press, as shown in one of the photographs. A ½-in. wooden dowel is covered with several layers of felt, treated with polishing paste, and placed in the jaws of the chuck. The drill press should be operated at next to low speed. The shape of the polisher makes it easy to get into the curves. Neat-looking hinges are then added to complete the cigarette box.



The completed box with initial and border copper-plated on the top. *At left*: Mitering the ends of the sides, front, and back at an angle of 45 deg. on a home workshop saw with a tilting table



The scalloped joint is cut on a jig saw and, after the box has been varnished, the indentations are polished by using a drill press

Bud Vases

Shaped from lead pipe

Four small vases made from ordinary lead pipe. The shaping requires no other tools than a hammer and a stick of hardwood

The bottom is closed by driving the metal in and fusing it with a torch

FROM such a common and cheap material as ordinary lead pipe, it is possible to make unique, decorative bud vases. The pipe, which should be about 1½ in. in size, is cut off to the length required and shaped with a ball-peen hammer and a length of round hardwood approximately 1⅜ in. in diameter, one end of which is rounded. Place the wood bar in the vise and slip the lead pipe over the rounded end. By working the lead over and around the bar, many different shapes may be formed.

To reduce the diameter of any part of the piece, simply hold it in the hand and hammer lightly around the outside. This will draw it down.

To close the bottom end and make it watertight, hold the piece in the hand and drive the metal at the end in toward the center until it is well closed. Then fill the piece with wet sand, turn it upside down, and apply the flame from a blowtorch on the center until it fuses, after which it may be hammered into shape.

Decorative lead pieces of this type are usually left in their natural finish.

Wherever necessary, the metal is expanded over a round bar of hardwood

OLD FELT HATS PROVIDE MATERIAL FOR MANY CRAFTWORK NOVELTIES

Key containers, holders for small drills, notebook covers, bookmarks, and protective pads may be made from old felt hats

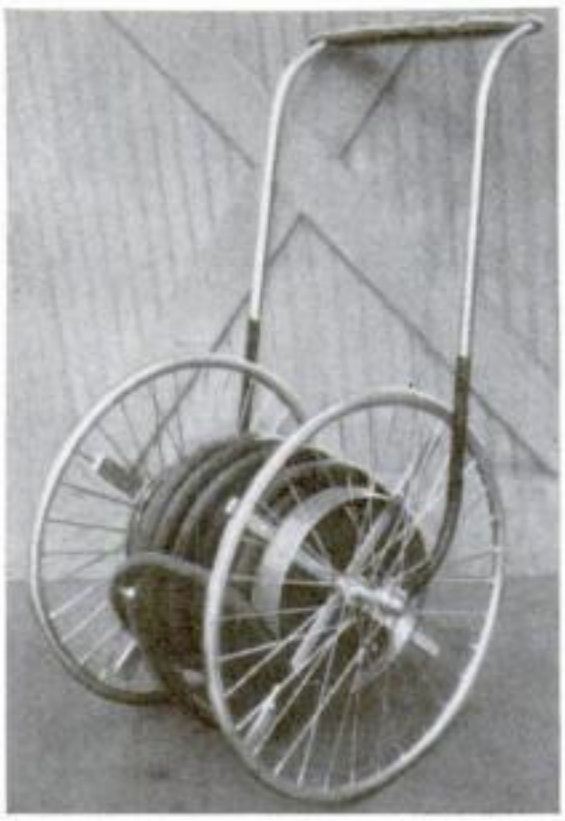
MANY small articles may be made from an old felt hat. With scissors, needle and thread, and dress fasteners, it may be turned into a key container for the auto lock, a holder for small drills, and a pad for hot dishes. Or it may be glued to the bottoms of book ends, picture mounts, ash trays, or various other novelties and ornaments to prevent scratching the polished surfaces of tables or mantelpieces. Other articles that can be made of felt are flexible notebook covers, a cover for a padlock to prevent freezing in winter, a lens hood for the camera, and a carrying case for a fisherman's flies.—C. B. SMITH.

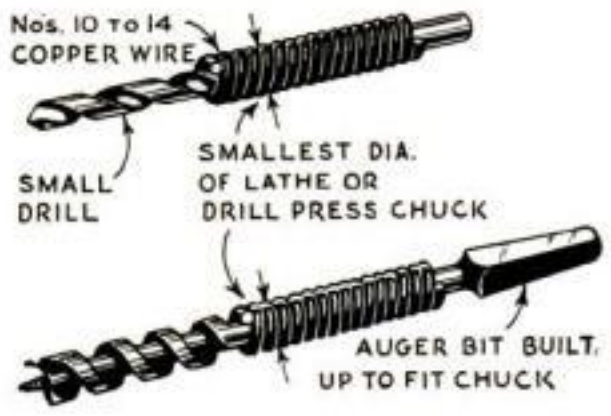
GARDEN HOSE REEL MADE FROM JUNK

THIS light, easily handled garden hose reel was made entirely from junk. It is much lighter and more convenient to use than the average reel, yet the construction is strong and substantial.

The wheels were taken from an old baby carriage found in a vacant lot. The drum is a discarded industrial alcohol steel can of heavy gage. The bottom had to be removed from the can and four slots cut in at either end to take the steel straps. The latter were obtained from the baby carriage; and as they were of spring steel, they had to be heated to a semi-white heat over a gas flame to remove the temper in order to drill a center hole for the axle and to cut them to measure with a hack saw. The handles were also obtained from the carriage.

The whole was finished with aluminum, and parts of the handles and the spokes were painted red. It would be hard to find a better 100-ft. garden hose reel in the market, yet the total outlay was only forty-five cents.—WILLIAM A. ROBBA.





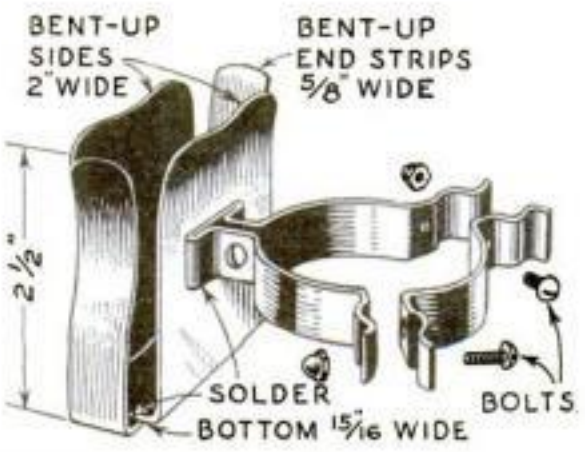
HOLDING SMALL DRILLS

LARGE lathe and drill-press chucks often will grip nothing smaller than ¼ in. in diameter. I frequently found it necessary to change chucks until I discovered that a small rod or shank could be enlarged by wrapping it with a dozen or more close turns of from No. 10 to No. 14 copper wire. If the drill wabbles, loosen the chuck and turn the drill part of a revolution. In emergencies, square-shank auger bits may be wrapped for use in a three-jaw chuck.—DONALD R. FOSLER.

Brass Clips on Smoking Stand Hold Pipes and Tobacco Can

Holder added to pedestal smoking stand for pipes and tobacco

A PIPE and tobacco can kept in the tray of a pedestal smoking stand such as is illustrated at the left soon become buried with ashes. If, however, a piperack and tobacco-can holder are made as shown, a pipe smoker may enjoy his smoke without digging for his pipe under a mound of ashes.



The material used is 1/16-in. brass strip, one piece 2 in. wide and the others 5/8 in. wide. The brass is heated to redness and quenched in water to anneal or soften it before it is bent. Brass machine screws, especially if they are fitted with acorn-headed nuts, enhance the appearance. Spot-circling the face of the can holder on a drill press by using a dowel with a small piece of emery cloth on the end is also an effective method of making the holder appear more attractive.

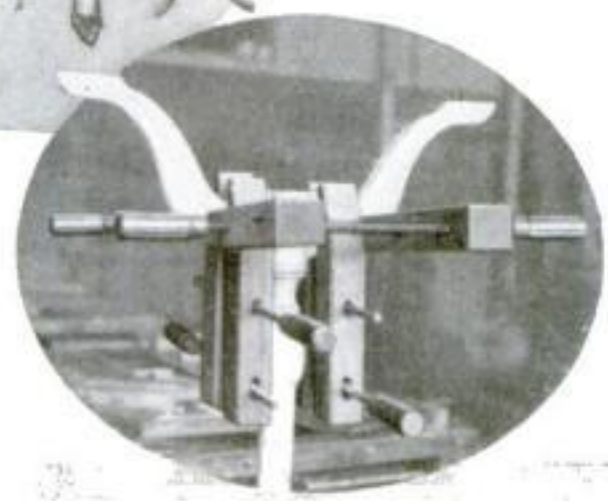
The side clips of the can holder are soldered under the face piece, which in turn is soldered to the band piece. The inside of the band pieces should be lined with adhesive tape or felt to prevent any marring of the smoking stand.

Strong nitric acid will clean the brass and leave it bright. Immerse the work in the acid for two or three seconds only, then plunge it immediately in water. A coat of metal lacquer will prevent the tarnishing of the bright surface thus produced.—R. W.

Novel Three-in-One Nest of Tables

By Herman Hjorth

The tables in use and, below, method of clamping legs to turned columns



NOVELTY and exceptional beauty of design are combined in this nest of tables. It differs from the usual types in that the additional table surface consists of two round-topped stands, which can be completely detached from the main table and placed anywhere in the room. This enables them to be moved where most convenient to serve refreshments to guests who are sitting at some distance from the table proper.

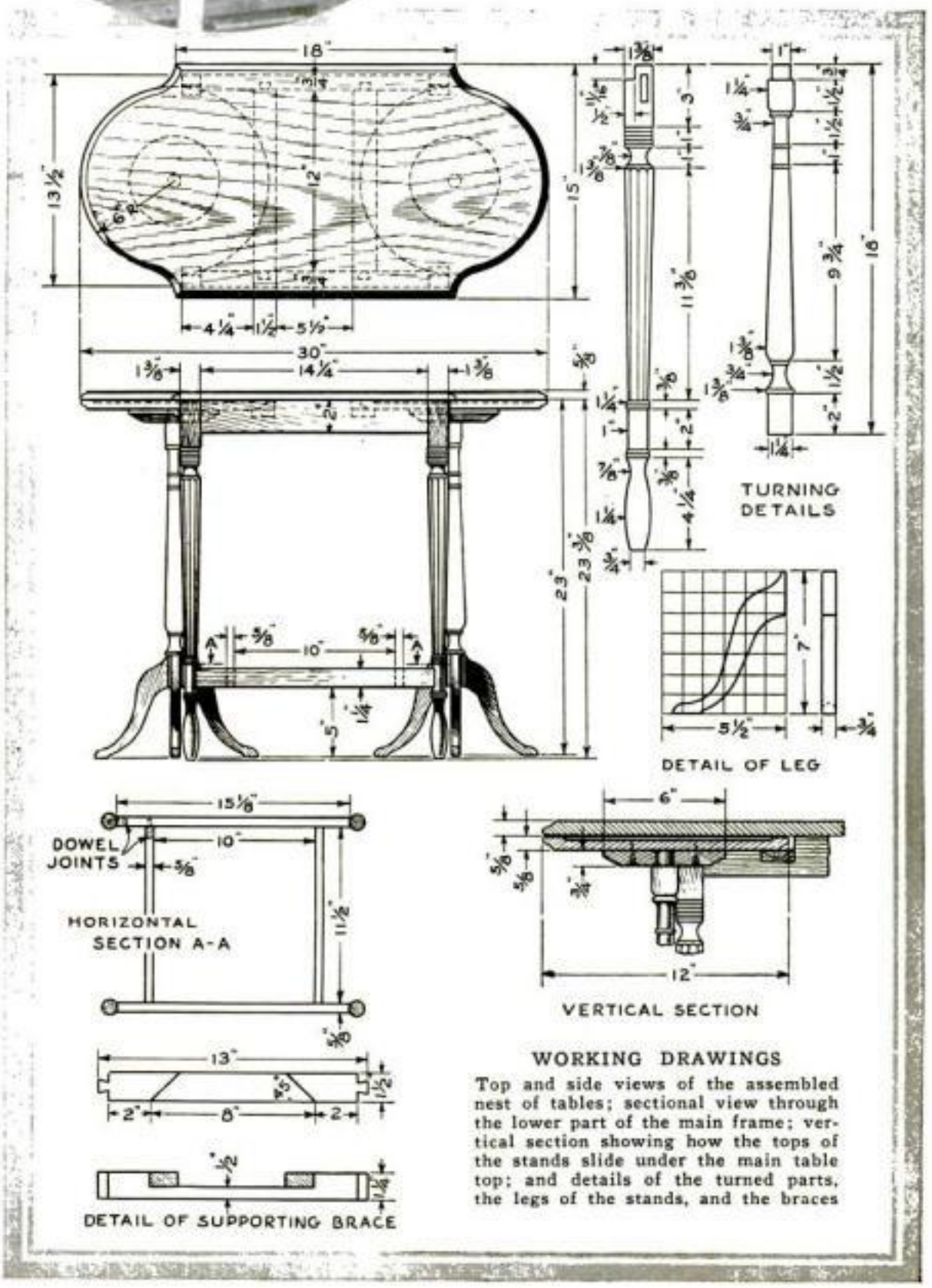
It is best to begin the work by making the two stands. Turn the two columns between centers and cut out the eight legs on the band saw. These are rounded and smoothed with file and sandpaper, and joined to the columns with two dowels each. The ends fitting against the columns are shaped to the right curvature by sanding on a spindle sander. A sanding device of this type can easily be made by turning a cylinder 1 in. in diameter and about 12 in. long. Glue to this cylinder a piece of No. 1½ sandpaper cut so that its edges just meet when it is wrapped around the wood. Glue is applied to the cylinder and the sandpaper is held in place by wrapping a piece of bandage or string around it. Rest the leg on the tool rest of the lathe and press it evenly against the revolving spindle sander as shown in one of the photographs. Test each leg with a steel square to see if the sanded surface is square to the part of the leg which is to stand on the floor.

Locate the holes for the dowels by gaging legs and columns with a marking gage. Two opposite legs are glued to the column at the same time and clamped with handscrews as illustrated.

The tops for the stands are turned by gluing them to waste stock with paper between. The top of each stand is fastened to the columns by means of a circular disk or plate, which is glued to the upper end of the column and screwed to the underside of the top.

The construc- *(Continued on page 105)*

A sanding cylinder is used in the lathe to shape the legs to fit against column of stand



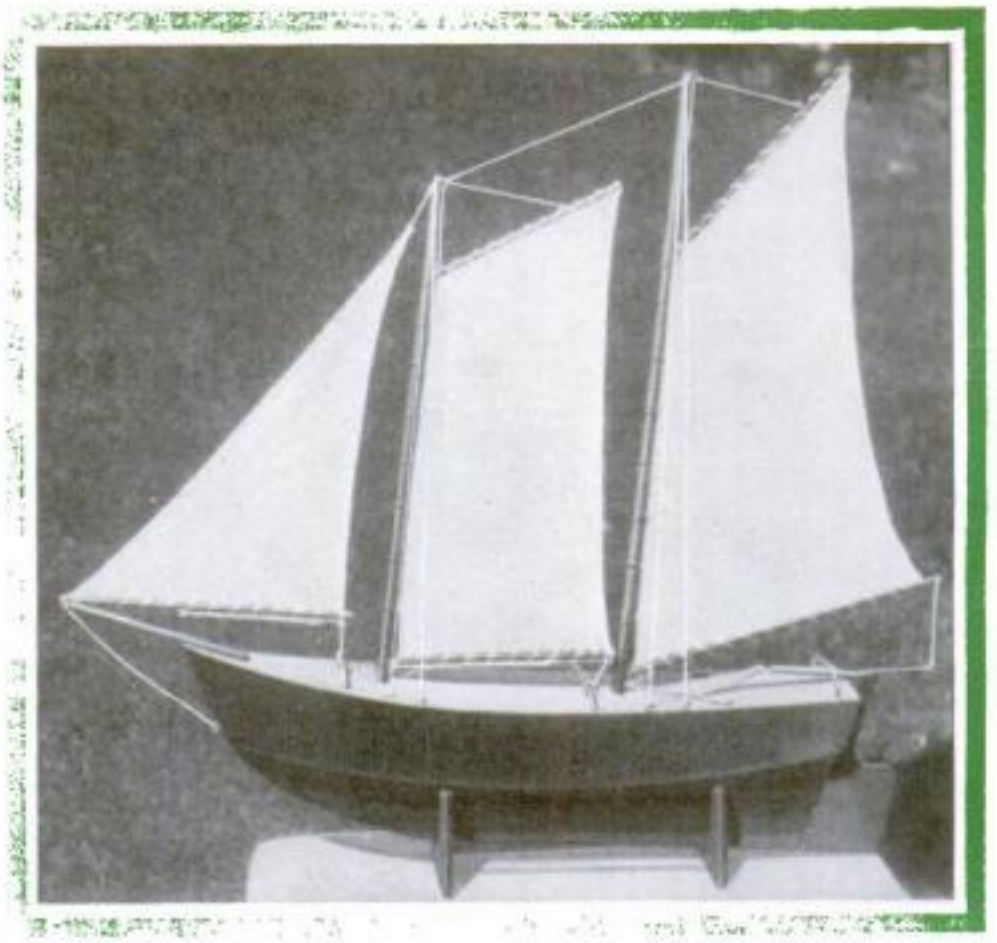
WORKING DRAWINGS

Top and side views of the assembled nest of tables; sectional view through the lower part of the main frame; vertical section showing how the tops of the stands slide under the main table top; and details of the turned parts, the legs of the stands, and the braces

A SPEEDY

Racing Schooner

SIMPLIFIED FOR BOYS TO BUILD



A stiff, fast sailer, this schooner holds her own well with ordinary racing yachts up to 30 in. long. Her hull is only 24 in. long but is of such a design that she stands up and keeps steadily on her course in a way that always surprises the onlookers

By
E. F. Walaron

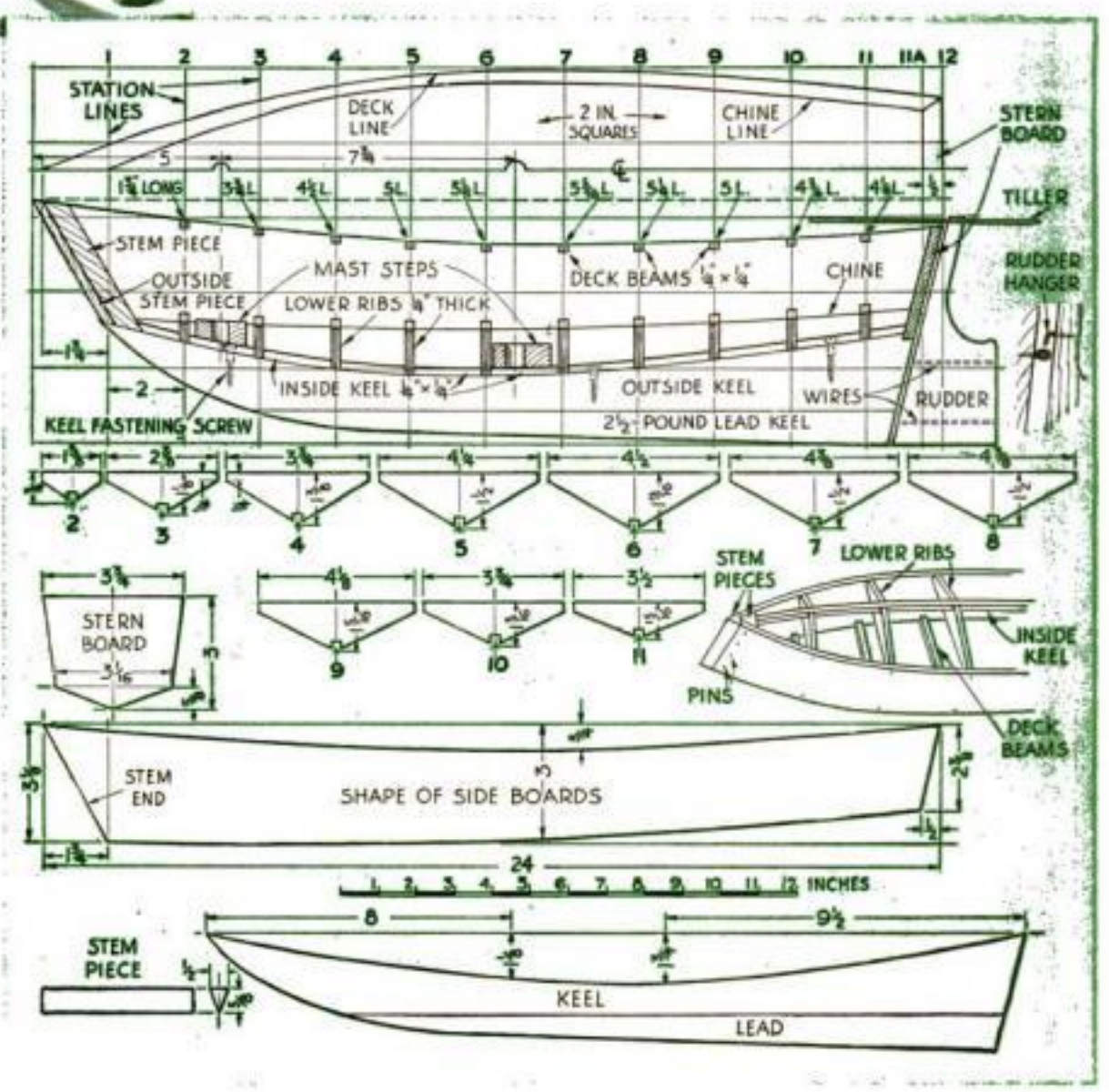
WHEN building miniature boats, some of us prefer sailing rather than shelf models. The author has devoted himself exclusively to sailing models that are planked or built-up instead of being dug out or made on the "bread and butter" plan. The construction has been so simplified that ten- or twelve-year-old boys can undertake some of the models, which are graded in difficulty and designed to develop skill to the point where it is possible to produce complicated operating models of modern steamers, yachts, or sailboats, true in form and line, pleasing to the eye, and efficient in the water. Very few tools are required.

The little schooner illustrated is an excellent beginner's model. It is not a copy of any existing boat, nor is it intended as such. The rig is similar to certain river schooners that I knew years ago. After you have built this boat, you may, by using certain modifications of the lines and a few added tricks of construction, improve your craftsmanship to the point where it is possible to build any hull desired.

In spite of her very elementary characteristics, this schooner is a stiff, fast sailer. The simplified rig makes for speed in sail adjustments. In races with boats under 30 in., she will place frequently if handled reasonably well.

All of the material can be bought for about a dollar, or less if you find some egg boxes with thin sides that can be used. The wood I prefer is soft white pine.

This boat is built with glue. My preference is for a celluloid cement, and I use so much of it that I make my own. I place about ½ lb. of old celluloid side curtain lights from old cars, photographic films from which the emulsion has been removed, or even old celluloid toys and toothbrush handles into a quart bottle with a wide mouth and fill the bottle with acetone. It is allowed to remain an hour, then stirred vigorously for about five minutes



The Easiest Sailing Model to Make

"LET'S build a sailing yacht model," is what thousands of boys are saying these days. That is because their enthusiasm has been aroused to a high pitch by the coming international yacht races. An accurate scale model of a cup defender, however, is exceedingly difficult to build and does not sail very well because it is too narrow, too light, and carries too much canvas.

This schooner model is a much more practical model for a boy. The drawings may look complicated, but once you get started, the parts seem to fall in place by themselves. No difficult carving or shaping has to be done.

The boat was designed especially as a beginner's project by Mr. Waldron, a school superintendent whose hobby is model boat building. He has gained such wide recognition for the simplicity of his methods that he often gives lectures and courses for manual training teachers on this ingenious type of construction. The schooner model is the simplest he has ever made.

Once the method of construction has been mastered, a boy can construct as large and ornate yachts as he pleases

and corked tightly. The next day it is stirred until evenly mixed. It should have the consistency of thick cream. If you use this type of cement, do not place it close to a flame or it will burn. It will dry very slowly if some white shellac is added.

For tools you need a coping saw or jig saw, a small plane, a very stout razor-blade knife, a sharp pocketknife, a fine-tooth hand saw or cabinetmaker's miter saw, a pin drill and drills No. 50, 55, 60, and 65, a light hammer of about 2 oz., sandpaper, a screw driver, and a few ½-in. No. 4 roundhead wood screws and washers. A jeweler's saw frame and blades are useful, as are round-nose pliers and a hand drill.

On one ⅛-in. board (see list of materials) lay out a sidepiece. Tack this board to another and saw out both at once. Separate them and mark vertical lines 2 in. apart on both, beginning at the stern. These are the station lines for the lower ribs and deck beams. Plane the ½ by ⅝ by 10 in. piece to a triangular shape of the dimensions shown for the stem piece. Cut it into two 5-in. pieces.

Drive two 8-penny nails into a board on the bench till rigid; have them about 4 in. apart. Lay one of the 5-in. pieces with the back or ½-in. side against the two nails. Apply glue to the front end of one of the sides and nail it to the stem piece with ½-in. No. 20 brass escutcheon pins, as shown. Next lay this side flat in the jig, and nail and glue on the other side board. See that the stem is vertical. Now set this aside to dry while cutting out the lower ribs as shown. Cut a notch in each ¼ in. square for the keel. Cut out the stern board, too, but do not notch it.

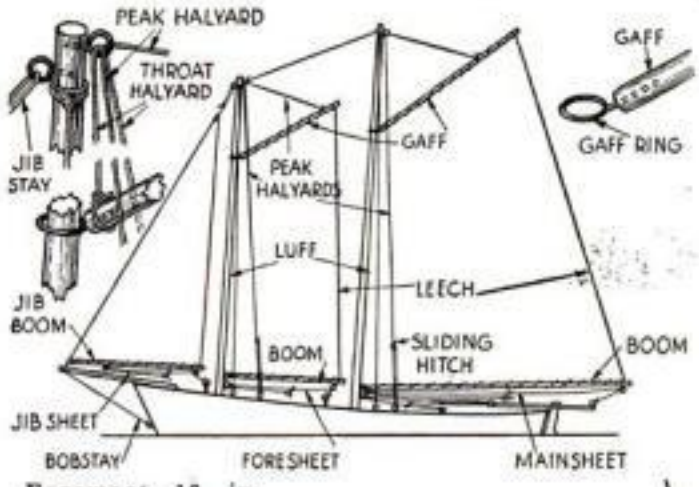
The keel is now cut from the ½-in. board. Plane the front edge to a point. Saw off the part which is to be replaced later with lead. This piece may be used as a pattern to mold the lead keel.

After an hour and a half, if you have used celluloid cement, you are ready to proceed. Hold the stern board in a vise, put glue on one edge of it, and nail one sidepiece to it. Turn it over in the vise and glue and nail the other side. Use plenty of cement.

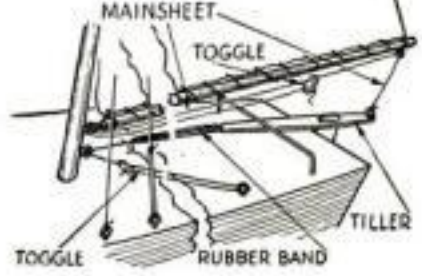
Spring the sides apart and slip the lower ribs into place at their proper stations. Set the ribs in so that the bevel begins at the edge of the side. Drive an escutcheon pin into each rib from each side. Make the inside keel from ¼-in. square wood. Fit it inside the inside stem in the notches of the lower ribs, and spring it over to, and inside of, the stern, as shown. Hold in place with glue and pins.

Turn the frame over and put in the deck beams. They are cut according to the lengths given on the plan from ¼-in. square stock. Mark a center line on each. Force each beam into place and hold with glue and a pin at each end. When completed, smooth the top of the inside stem flush with the sides.

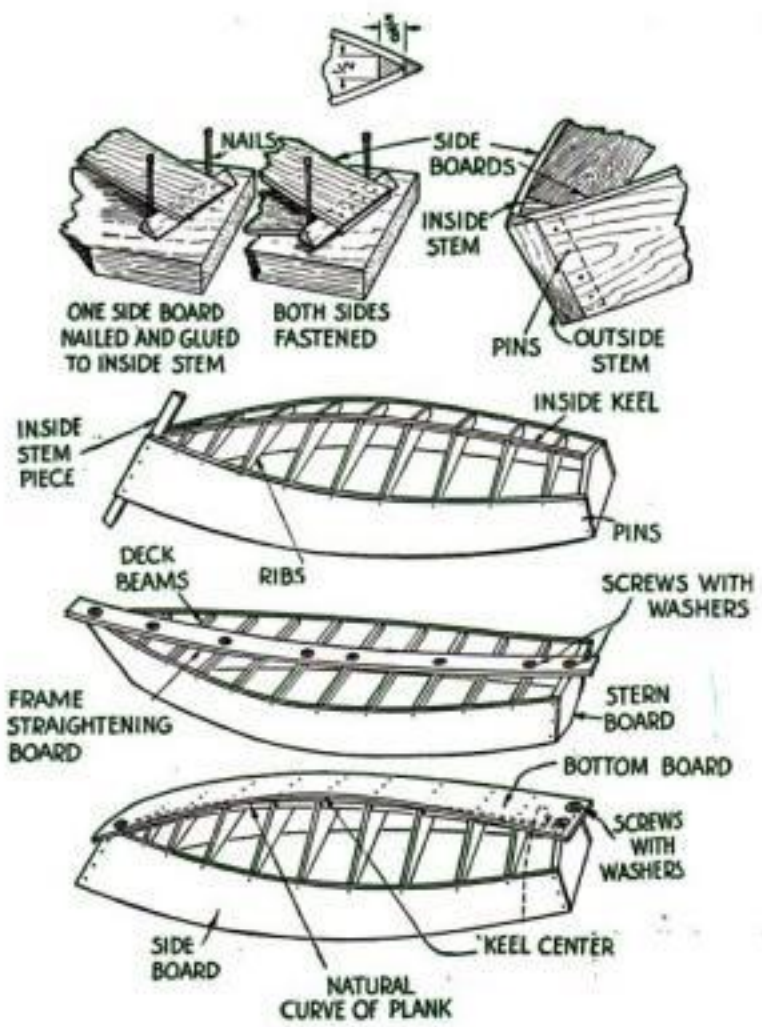
Take one of the 2-in. pieces of ⅛-in. stock, mark a center line on it, and screw to the deck beams with screws with washers under them so that the center line of the boat, as indi- *(Continued on page 102)*



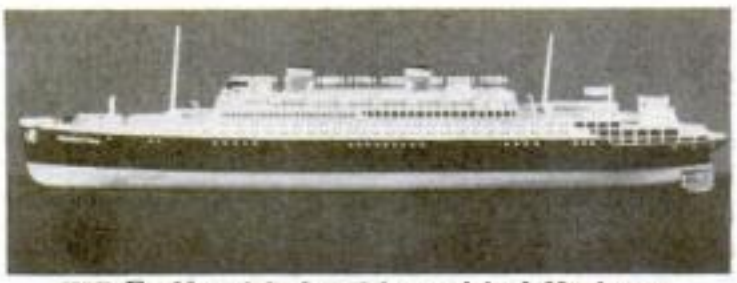
Foremast 18 in. above deck, 4¾ from bow. Mainmast—22 and 12¼. Foresail—luff 13, leech 16¼, boom 6½, gaff 6¼. Mainsail — luff 15, leech 21⅝, boom 15, gaff 10. Jib boom—7½. Bowsprit—6½



The rigging plan. Both masts rake backward ⅛ in. The bowsprit overhangs the bow 4 in.



Steps in constructing the hull. The side planks are fastened at stem and stern board, and the ribs are then sprung in place



KIT F—Materials for 12-in. model of *Manhattan*

KIT G

GET STARTED IN Model Making WITH OUR *Construction Kits*

The historic *Hartford*—KIT L

NO. 5

KIT D

KIT H

NO. 6

NO. 4

KIT E

IN ADDITION to the new model-of-the-month kits, listed on page 96, we offer readers a number of other ship model and furniture construction kits. These contain all the materials necessary for making the various projects illustrated on this and the following page.

Each of the construction kits has been prepared with the idea of making it easier for readers to take up handicraft at home, which is now so rapidly becoming one of the most popular hobbies. There is, indeed, no hobby that is more genuinely satisfying or has more real or lasting value.

Our ship model kits, designated by letters, contain only the raw materials—that is, no work has been done on any of the parts, with the exception of the hull blocks. In kits F, H, and J, a certain amount of preliminary shaping has been done on the hull. In the case of the larger models, the hull lifts will be sawed out or the blocks will be shaped, depending upon the type of model, at a slight additional cost.

Our furniture kits, on the other hand, are completely finished in respect to sawing, surfacing, turning, boring, and other machine operations. All that remains to be done is the necessary hand finishing and assembling. While doing this work, however, you will learn a great deal about building furniture at home, because these pieces are of the finest design and workmanship. They are the equal of the best custom-made furniture.

All kits are accompanied by instructions or full-size blueprints.

A. Whaling Ship model *Wanderer*. All the raw materials (except paints), Blueprints Nos. 151 to 154, and a booklet. The hull is 20½ in. long..... $6.90
AA. Same with hull lifts sawed.... 7.40
D. Spanish galleon ship model, 24 in. long. All the raw materials (except paints), Blueprints Nos. 46 and 47, and a booklet 6.45
DD. Same with hull blocks shaped.. 6.95
E. Battleship model, U.S.S. *Texas*, 3 ft. long. All the raw materials (except paints) and Blueprints Nos. 197 to 200..... 6.95
EE. Same with hull lifts sawed.... 7.45
F. Liner *Manhattan*. All raw materials for a simplified miniature model 12 in. long, and Blueprint No. 204..... 1.00
G. Elizabethan galleon *Revenge*. All raw materials (except paints) for a model 25 in. long, and Blueprints Nos. 206 to 209.. 6.75
GG. Same with hull blocks shaped. 7.25
H. Cruiser U.S.S. *Indianapolis*. All raw materials for a simplified 12-in. model, and Blueprint No. 216..... 1.50
J. Clipper ship *Sea Witch*. All raw materials for a simplified 13-in. model, with blueprint..... 1.50
L. Farragut's flagship *Hartford*, a steam-and-sail sloop-of-war. All raw materials (except paints) and special Blueprints Nos. 221 and 222. The hull is 33½ in. long, and the over-all length is 41 in. 7.95
LL. Same with hull lifts sawed ... 8.45
No. 2. Solid mahogany tray-top table 23 in. high with a 15 in. diameter top. Ready to assemble, but without finishes..... 5.40
No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble, with finishes.. 5.30
No. 5. Solid rock maple hanging wall rack with one drawer, 19½ in. wide, 33¼ in. high. Ready to assemble and stain included 5.75
No. 6. Solid rock maple butterfly table, top 19 by 22 in., height 22½ in. Ready to assemble and stain included..... 6.90

KIT J
Materials for a miniature clipper ship

NO. 2

KIT A

Popular Science Homecraft Guild,
381 Fourth Avenue, New York, N. Y.
Please send me Kit.....for
which I inclose $..... (or send C. O. D. ☐)

Name .....

Address .....

City..... State.....
(Please print name very clearly.)

Note: Prices of all kits except *F*, *H*, and *J* are 50 cents higher west of the Mississippi River because of heavy shipping charges. We prepay the postage on both cash orders and C. O. D. orders, but if you order C. O. D. you will have to pay on delivery the extra charges made by the Post Office, which amount to 28 cents. Kits *F*, *H*, and *J* cannot be sent C. O. D. This offer is made only in the United States.

HIGH-SPEED HOMEMADE

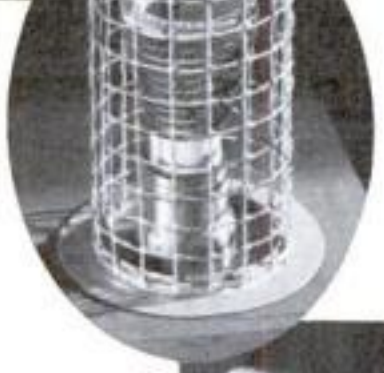
Photo Printing Machine

Enables Amateur to Make Money Out of His Hobby

By L. D. Eldridge

The opening in the table for the printer head and catch basket. Some wiring is in place, and the machine is ready for the lamp house to be installed

This machine operates faster than usual because the prints slide automatically into the catch basket

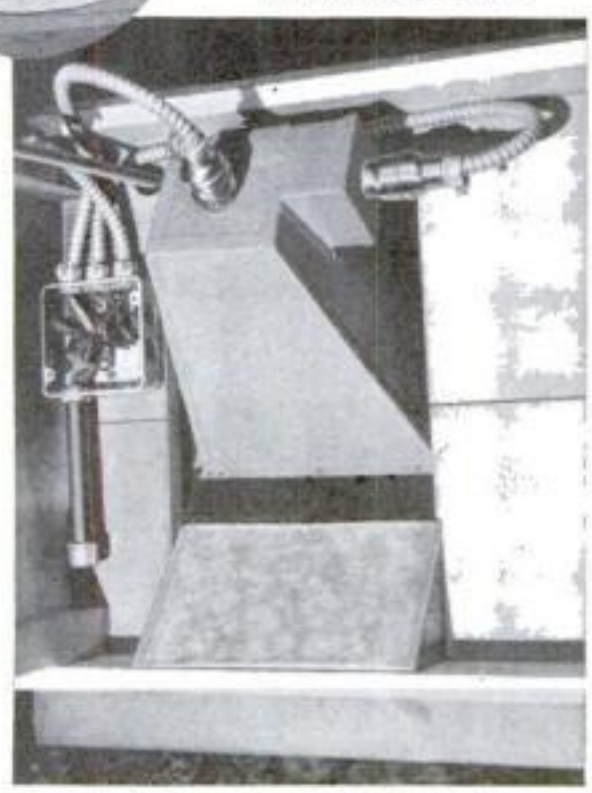


A resistance for dimming the printer light is supplied by a well-guarded heater element in a light socket

AMATEUR photographers who have learned to develop and print their own pictures will find a pleasant as well as profitable hobby in finishing the exposures made by their friends. This side line may be extended indefinitely into making post cards of their locality and photographs of their friends, as well as Christmas cards and pictures for publication, and may even grow into a lucrative full-time business.

Work of this type may be carried on in a satisfactory manner only when one is equipped with a machine for producing the prints rapidly and economically. While the purchase price of such a machine would be almost prohibitive to the beginner, an excellent printer—the equal of many machines used by professionals—may be constructed at small cost in the average home workshop. The printer will easily run off 100 prints from one negative in less than ten minutes.

Two new features have been introduced which make for speed and efficiency—a tilted head from which the prints slide automatically, and a metal catch basket into which they fall in a neat pile, enabling the operator to give his entire attention to handling the unexposed paper.



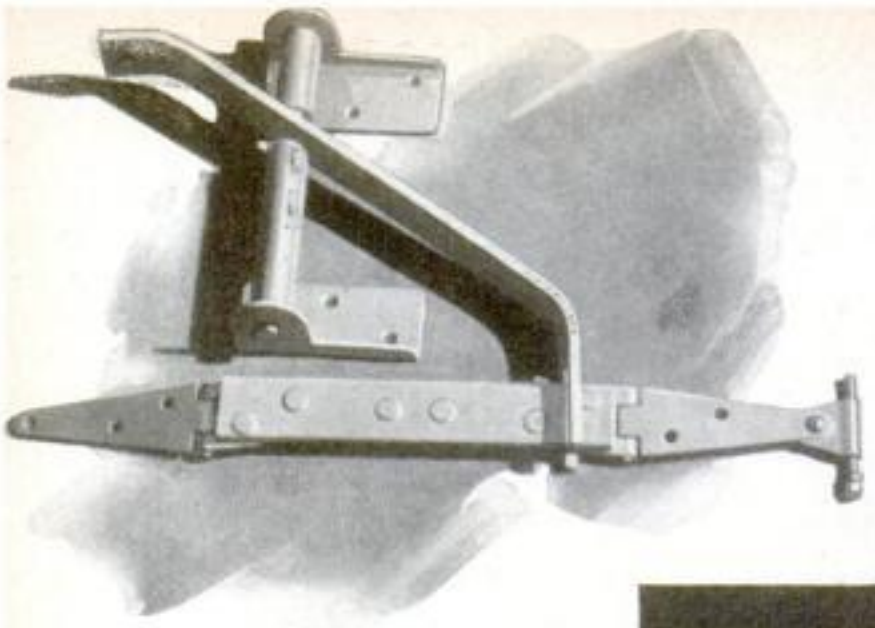
Underside of table. Note the junction box with pipe-nipple extension for carrying the wires to both the main and dimming switches

First saw the four legs of the table from material 3 in. square by 30 in. long. Mortise on two adjacent sides ¾ in. deep and 4 in. from the end to allow the rail to fit flush with the leg. The leg is tapered from the lower edge of the mortise to 2 in. square at the floor.

Rails should be cut from 1 by 4 in. material. The front and back rails are 36 in. long and sides 20 in., all pieces being mitered on a 45-deg. angle on each end. The table top is 23 in. deep by 38 in. wide, cut from two widths of 1 by 12 in. lumber. This is laid on the rails to allow the front to overhang 2 in., but the sides and back only 1 in.

In the table top, when completed, an opening 9½ by 16½ in. is cut for the printer head. The right side of the opening is 6 in. from the right side of the table top, unless one happens to be left-handed, in which case care must be taken in transposing.

The V-shaped catch basket is installed in the front end of the opening. The remainder of the sides and back are finished by a rail of 1-in. wood which rises at an angle of 30 deg. from the back edge of the catch basket, passes horizontally across the back of the opening, and tapers back to the catch basket on the opposite side. This rail is fastened in place by countersunk screws driven up through the table top from below, and



The rocker-arm assembly ready for installation. The diagonal arm is brazed to the axle

If one's hands are small and delicate, the bend in this piece of steel can be reduced

Another view of the two-piece platen. Note the hinges and the two small springs at rear

forms the foundation for the lamp house and printer-head assembly.

The catch basket may be made from a single piece of galvanized iron 12 by 19 in. Turn flanges B and B^1 up at right angles, and turn flanges A, C, A^1, and C^1 down at right angles. Side O is turned up and over to form an angle of 45 deg. with N, after which sides M and M^1 are turned up at right angles, and flanges B and B^1 are soldered to edges of O.

The lamp house is pyramidal in shape, as shown. If you are not something of a tinner, a little assistance may save quite a bit of grief. A small lamp house for the pilot light is cut into the main lamp house at the small end near the printer bulb. The pilot lamp house is 3 in. square, with two sides cut on an angle to fit the side of the main lamp house, and the other two sides extended to reach nearly across the base of the main house, forming a V-shaped opening for ventilation without emitting light. Bend the first two sides down to form a right angle along line rr^1; bend the second pair of sides up along line TV. Bend flanges up at AS and DS^1 and down at SV and VS^1. Lines AS and DS^1 on both pairs will coincide at opposite corners.

Two light sockets should be taken apart and the small end of the brass shell soldered into place on both lamp houses so that the complete socket will barely project through the iron. Be sure to scrape the lacquer from them before trying to solder. The cap will later be fitted to the conduit, connections made with the socket, and the two sections snapped together.

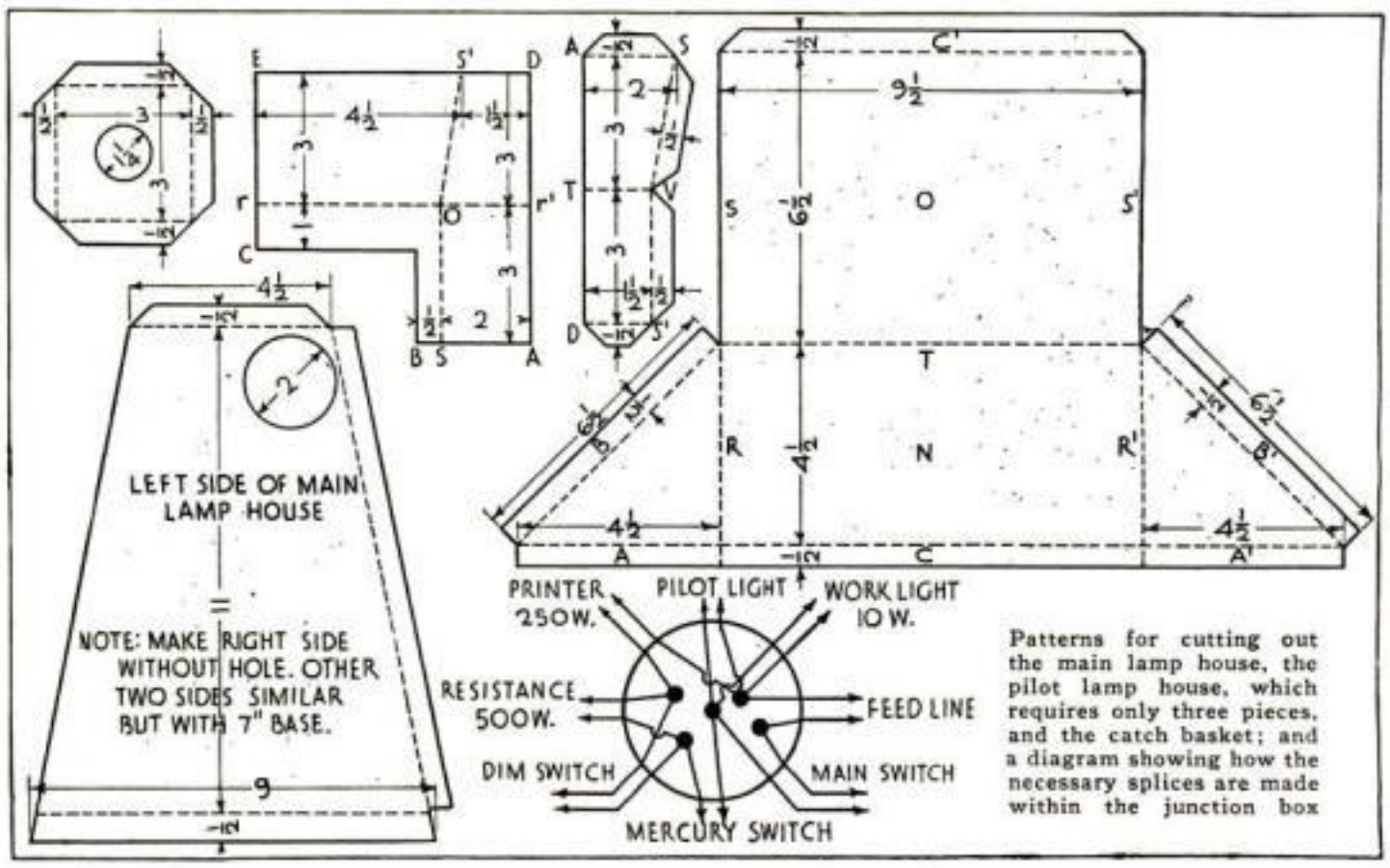
A flange on the open end of the lamp house will provide for fastening it to the printer head, which should be of 1-in. wood, 13 in. square. It is strengthened across the grain with a steel strap 1 by ⅛ in. at both top and bottom, placed underneath the head. The grain should run from back to front to permit prints to slide more easily. Sandpaper the wood and apply several coats of black varnish, with a light sanding between coats.

For the platen, obtain two thicknesses of good ¼-in. plywood, coat both pieces with furniture glue, and clamp them firmly together. When thoroughly dry, saw to 6½ by 8½ in. in size, again dividing this to make the back section of the platen 2½ by 8½ in., and leaving the remainder 4 by 8½ in. Hold the two sections firmly in position, cover again with glue, and apply to both parts a piece of soft felt at least ¼ in. thick. Allow this to remain under gentle pressure until the glue has set. This may then be cut with a sharp knife along the joint in the platen.

Dress a piece of 1 by 4 in. wood to a thickness to correspond with the total thickness of the platen and felt. Fasten this with countersunk screws to the top of the printer head so that it is flush with, and adjacent to, the platen when in position. Join each section of the platen permanently with hinges.

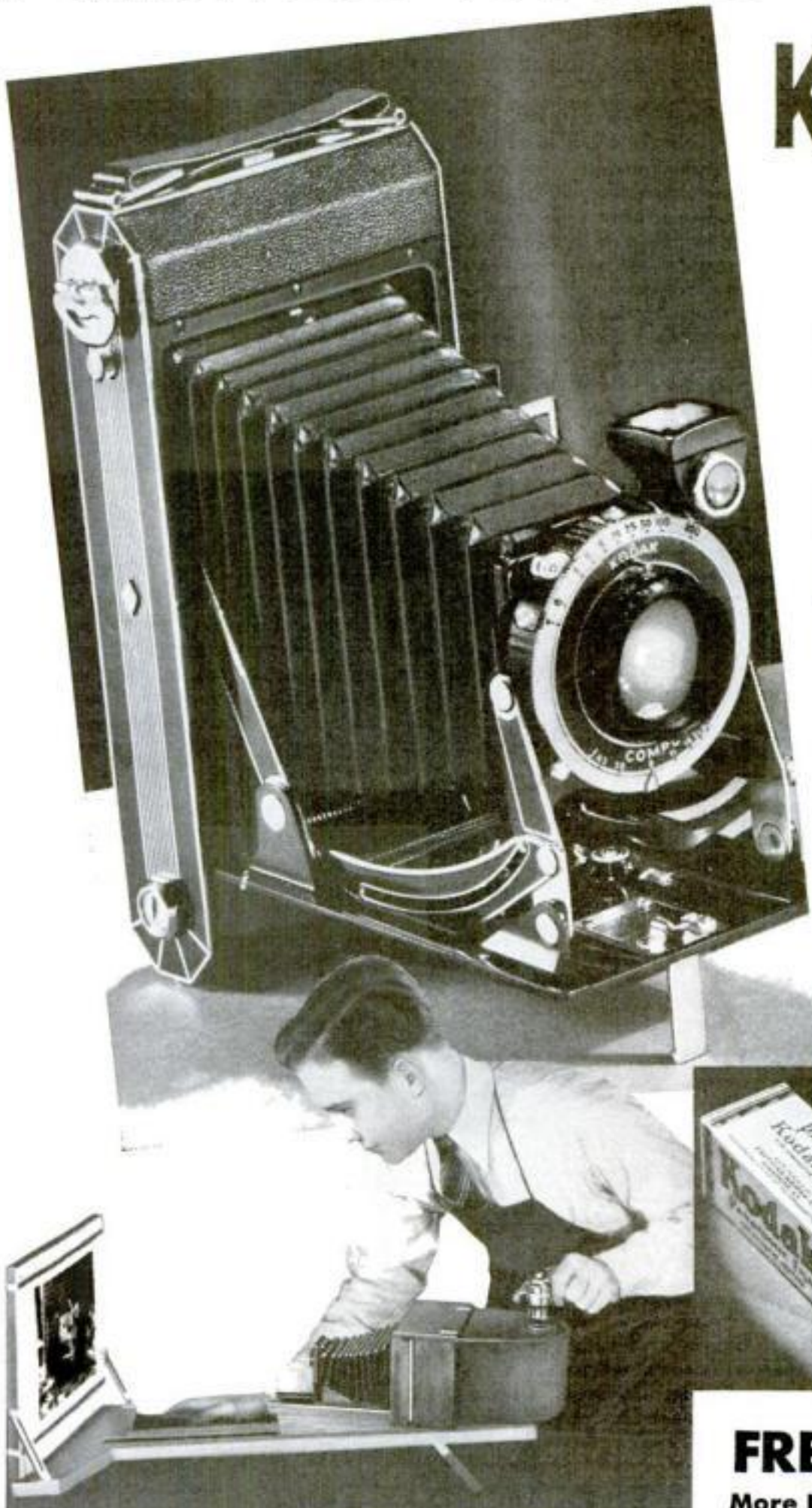
The angle between the two sections of the platen when open is important. It is controlled by a simple strap of iron bent to an angle of about 135 deg. and fastened to the lower portion of the platen as shown. Sufficient tension to hold the paper firmly until one's hand is removed and the front section can close is maintained by springs on either end of the back section of the platen, or small spring hinges may be used in place of the plain hinges.

Provide two strap hinges, 3 in. long, riveting each to a piece of steel 1 by ⅛ in. and long enough to space the joints 6¼ in. apart. On the free end of one hinge, fasten half of a third hinge with a small bolt. The other half *(Continued on page 98)*



Patterns for cutting out the main lamp house, the pilot lamp house, which requires only three pieces, and the catch basket; and a diagram showing how the necessary splices are made within the junction box

America's favorite fine camera_



Kodak Six-16

with the *f*.4.5 lens

A MARVEL OF PRECISION, compactness and beauty . . . the new Kodak Six-16 with *f*.4.5 lens will instantly appeal to those who know cameras.

It springs into action at the touch of a button—the fast Kodak Anastigmat lens (*f*.4.5) and the Compur shutter with its speeds from 1 to 1/250 second give you mastery of light and "action." Both conventional and eye-level finders make this camera flexible to use. With the built-in self timer, you can get in the picture yourself. Focuses down to 4 feet—short enough for interesting close-ups.

For 2½ x 4¼ inch pictures, Six-16 with *f*.4.5 lens costs $40.

Three films for the Kodak Six-16. *For outdoors*—Kodak Verichrome gives you bright, clear snapshots. It adds to the scope of the *f*.4.5 lens. *For indoors*—Kodak "SS" Panchromatic lets you make snapshots at night, using two or more Photoflood bulbs. *For enlarging*—Kodak Panatomic, the film with the microscopic grain. With the Kodak Six-16 *f*.4.5, you can fit your film to your subject.

DO YOUR OWN ENLARGING . . . Bring out *all* the beauty of your snapshots—enlarging does the trick. And now it's so easy with the Kodak Home Enlarger. Handy . . . accurate . . . simple to use—it takes all negative sizes up to 3¼ x 4¼ inches. Enlarges up to 11x14. Ground-glass focusing for sharpness. Metal clips hold the paper. Complete with lens—$16.50.

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P. S. 9-34

IF IT ISN'T AN EASTMAN, IT ISN'T A KODAK

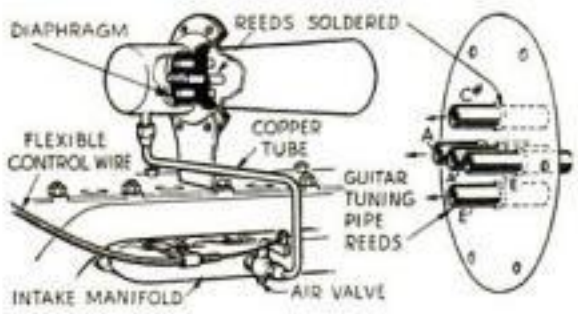
Ideas *for* Car Owners

Ingenious Suggestions Made by Our Readers That Will Save You Both Time and Trouble When Doing Repair Jobs on Auto at Home

AFTER several discouraging and unsuccessful attempts to tighten the tie bolt on a car spring after replacing one of the leaves, I hit on the idea shown in the illustration. It not only eliminates the necessity of fighting the combined power of the spring but it also makes it possible to tighten the nut with the full assurance that none of the threads have been stripped in the process. The method consists simply of placing the head of the tie bolt in the vise so that its shank projects up. Then, starting with the largest spring, the leaves are dropped over the bolt and fanned out like the spokes of a wheel as shown. When all of the leaves are in place, it is a simple matter to run the nut up on the bolt with your fingers. All that remains then is to push the leaves into place one above the other. This can be done by forcing them around as far as they will go by hand and finishing the job with a rubber mallet. The spring can be placed on the flat top of a bench and pounded until the leaves line up. If no rubber mallet is available, cover the springs with a protecting layer of heavy cloth and use a mallet of the wooden variety. The bolt then can be tightened.—C. M. G.

Stopping Vapor Lock by Cutting Out Preheater

IF YOU drive an old-style car and are bothered with chronic vapor lock, it will pay you to inspect the air intake on the carburetor. On many of the models brought out a number of years ago, a heater on the exhaust serves to warm the air entering the carburetor. This system worked out very well with old-style gasoline, but with the modern fuels it has a tendency to supply more preheating than is desired. The remedy, however, is a simple one. Merely unhook the flexible tubing that connects the heater to the carburetor by loosening the set screw that holds it in place and pulling the end of the tube free. This change has not only improved the general behavior of the writer's car but has given greater pick-up and a higher speed. Now, even in hot weather there is not the slightest indication of vapor lock.—L. Van T.



Musical Vacuum Horn Made of Odd Parts

BY COMBINING an old horn casing, a guitar tuner, some flexible copper tubing, an air valve, and a few other odds and ends, the amateur mechanic can assemble a novel musical horn for his car. Being connected to the intake manifold, the horn is operated by vacuum. As shown in the illustration, the tuner reeds, selected to form a musical chord, first are soldered in small holes drilled in the diaphragm. Then, when the rear horn chamber, which originally housed the fan motor, has been made air-tight, one end of the flexible tube is soldered over a hole drilled in the side of the casing. The other end of this tube leads to a lever-handled air valve (cock) mounted on the motor's intake manifold. Finally, a push rod leading to a convenient point on the dash board can be arranged for opening and closing the valve. When the valve is open, the air will be sucked through, and the reeds will sound their musical notes.—C. A. L.

New Suggestion for Polishing Car's Hood

TO ELIMINATE the back-breaking from hood polishing, the writer follows the method illustrated. The hood is lifted and then rested on a rubber or cloth pad placed on the front mudguard. Incidentally, the inexpensive sponge-rubber kneeling pads sold in most five- and ten-cent stores form a fine protection for the finish on the fender.—R. P.

Use Soap to Seal Air Valve

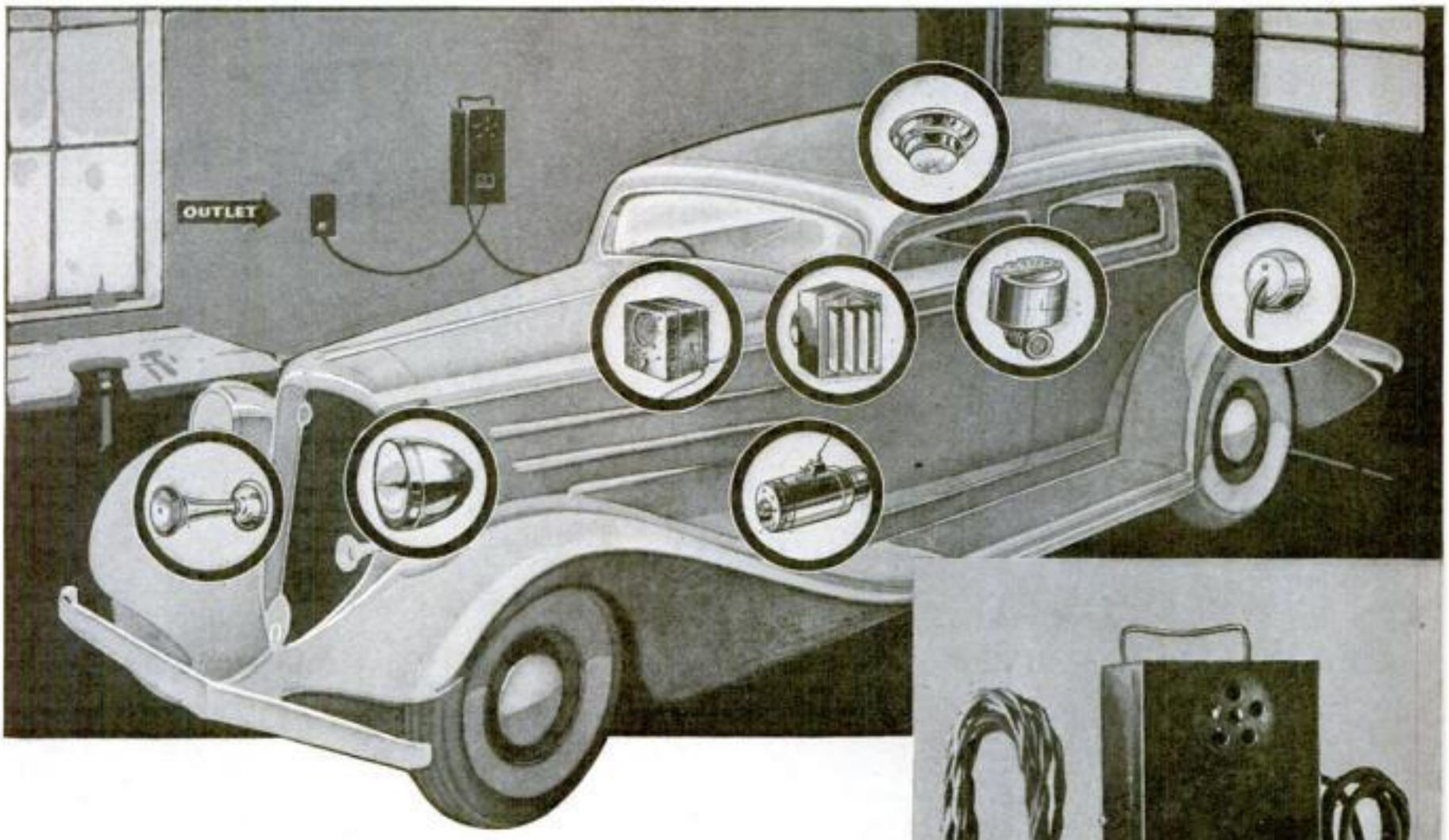
WHEN the valve on an automobile tire refuses to close properly, causing a slow leak, it can be repaired with soap. Select a piece of soap that is soft from recent use and, after removing the valve from the tire stem, smear a bit of the soft soap on the rubber insert or seat and also on the rubber plug. The film of soap will form a perfect air-tight seal unless the valve is too badly worn.—K. M.

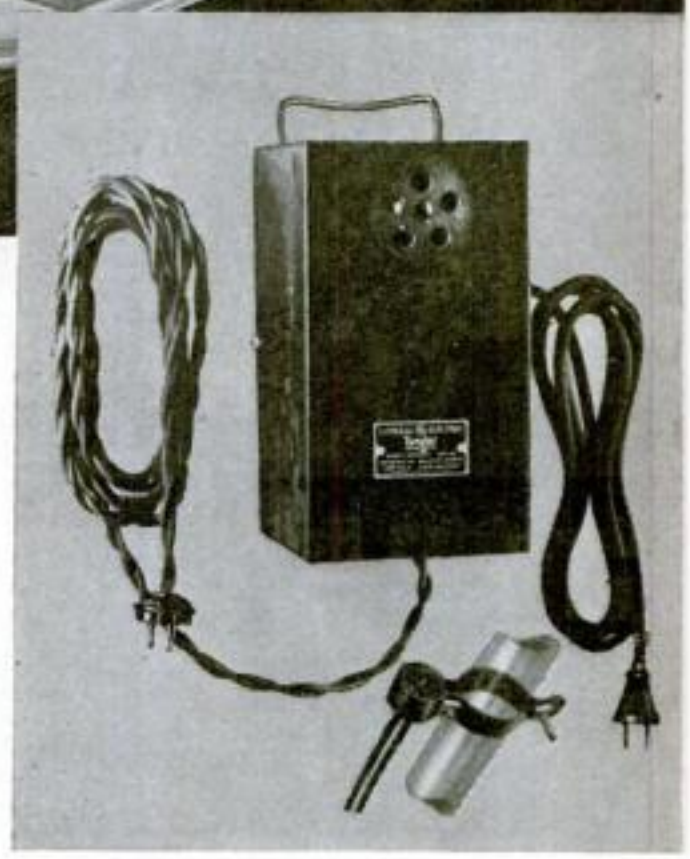
Sponge on Garden Hose Speeds Car Washing

AN ORDINARY sponge, with a hole cut in it to take the nozzle of a garden hose, will form a handy addition to your car-washing equipment. The sponge, which can be wired in place or held with your hand, will prevent the water from splashing. Also, because fresh water is always being applied, the sponge will not smear or smudge. One rinsing is all that is required.—H. A.

Sponge, into which nozzle of garden hose is inserted, lightens the job of washing your car

CHARGE YOUR RUN DOWN BATTERY IN YOUR OWN GARAGE





$12.95 BUYS THIS COMPLETE HOME BATTERY CHARGER

(Prices slightly higher West of Rockies)

Look at all the electrical accessories on your car . . . headlights, horns, heater, radio, dome and dash lights, cigar lighter, tail-lights, etc. All of them contribute to your safety and pleasure while driving. Yet they all are made possible by the storage battery which furnishes the necessary power. Don't sacrifice these comforts merely because they discharge your battery.

The New Tungar Home Charger guarantees a fully charged battery at all times. It delivers a full 5-ampere charge. Like any appliance, you simply plug it into any A-c. electric outlet. No messy floorboards to handle. Wiring accessories furnished permit easy connection of Charger to battery through special outlet on steering post. For a few cents, the 5-amp. Tungar operates safely all night. Batteries are protected from over-charging and power failure. The 5-amp. Tungar prevents run-down battery troubles before they start. It assures proper operation of all the electrical accessories on your car. See your dealer or mail the coupon today for complete information.

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General Electric Company,
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Please send me complete information on the 5-amp. Mercury Tungar Battery Charger.

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AUTOMOTIVE PRODUCTS

MERCHANDISE DEPARTMENT, GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT

UNICYCLE FOR TRICK RIDING MADE FROM OLD BICYCLE

The front fork is straightened, shortened slightly, and fitted with suitable bearings for the hanger bars to which the pedals are attached. A block of wood is carved out to form the seat

TIRED of riding an ordinary bicycle? Then try the stunt of converting it into a unicycle and learn to ride on one wheel, like a vaudeville performer. It is not as hard as it looks. In fact, the boy who is on the unicycle shown in one of the accompanying illustrations thinks nothing of riding the wheel to and from school, much to the amazement and entertainment of his schoolmates. He has won prizes racing on it and has given stage performances. With practice, anyone can learn to balance himself on a wheel of this kind.

The unicycle is made from the front fork and rear wheel of an old standard bicycle with a few inexpensive attachments added. The difficult part of the work can be done by any competent blacksmith. It is necessary to straighten out the curve in the fork and cut off the lower ends of the prongs just above the holes through which the fork was originally attached to the bicycle wheel. The handle bars are removed, and a piece of airplane tubing is inserted in the upper end of the fork to form an adjustable support for the seat. The seat itself may be carved from a thick piece of wood to the shape of a saddle seat. Elm is an excellent wood for the seat block.

A babbitted bearing or a suitable automobile cam-shaft bearing is used, and through this is run the hanger bars to which the pedals are attached. Both the bearing and hanger bars are best made of drop-forged steel fashioned in the blacksmith shop. The hanger bars are forged in one piece. Ordinary bicycle pedals are used. A study of the detail photograph will make clear the method of assembly.—MAMIE R. CULLEN.

STARTING VERY SMALL SCREWS

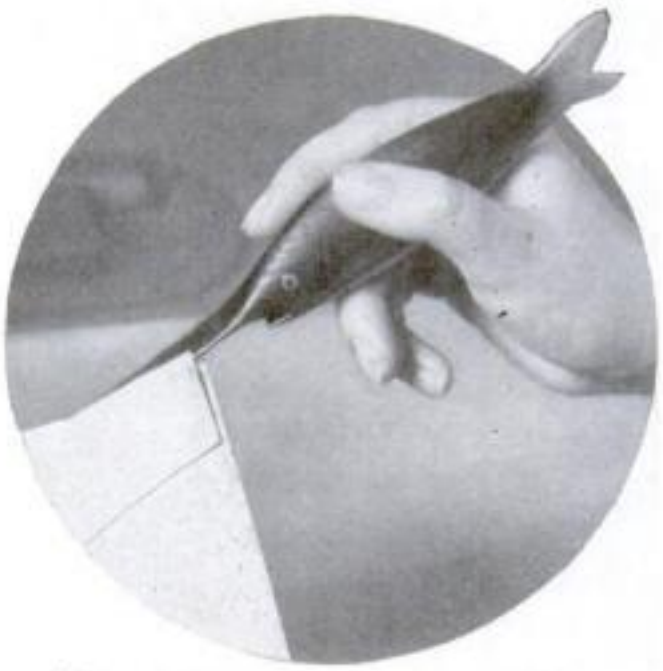
THE delicate task of inserting very small screws into their holes can be made easy by attaching a bit of chewing gum to the point of the screw driver.—R.R.A.

PAPER KNIFE IN SWORDFISH SHAPE

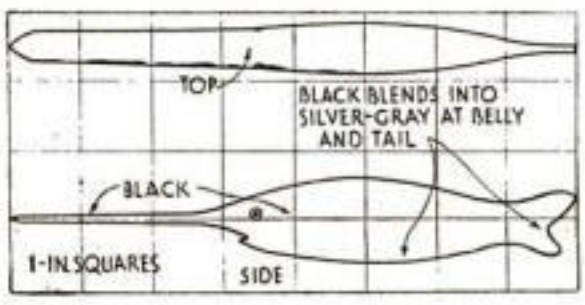
THE swordfish paper knife illustrated at the right is a unique and useful ornament for the desk, and will be especially appreciated by the man who makes fishing his hobby. The only tools required are a saw, a pocketknife, and sandpaper.

The design is laid out full-size on a piece of paper with the aid of 1-in. squares, as shown below, and then transferred to a block of close-grained hardwood about ¾ by 1¼ by 8 in. The fins are best left off, although a suggestion of them may be added if desired. Saw the piece roughly to shape, and finish the shaping with a knife. Note that the sword is flat when viewed from the top, not the side. With rough sandpaper, give an edge to each side of the sword, then finish the entire fish with fine sandpaper.

To prevent the colors from wearing off when the fish is put into use, use artist's oil colors as a stain, rubbing them well into the wood; or use ordinary paint or enamel, made quite thin with turpentine. If desired, several coats of clear varnish may be added to give the fish a "wet" appearance.—CARL SORENSEN.



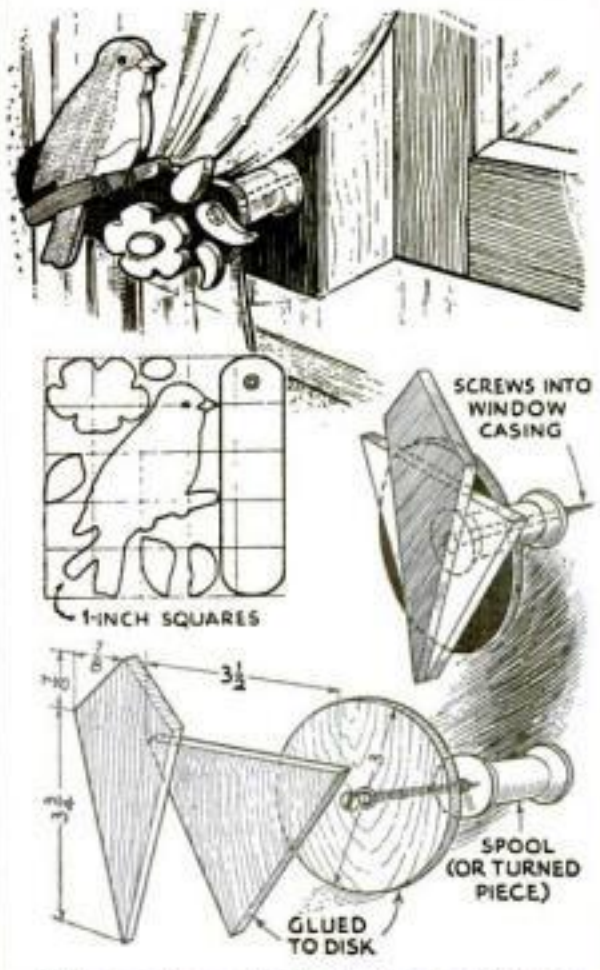
Whittled from a piece of hardwood, this paper knife is a novel ornament for a fisherman's desk



PREVENTING SKIN ON PAINT

A LITTLE turpentine poured over the surface of paint or enamel when not in use will remain on top and prevent a skin or scum forming over the top of the paint.

DECORATIVE HOLDBACKS FOR WINDOW CURTAINS



Bird and flower holdback for an informal room, and a modern design for living rooms

SMALL pieces of thin wood, spools, and long flatheaded screws are the materials for the little curtain holdbacks illustrated. Basswood ⅛ in. thick is recommended. Ornamental turned shapes might take the place of spools.

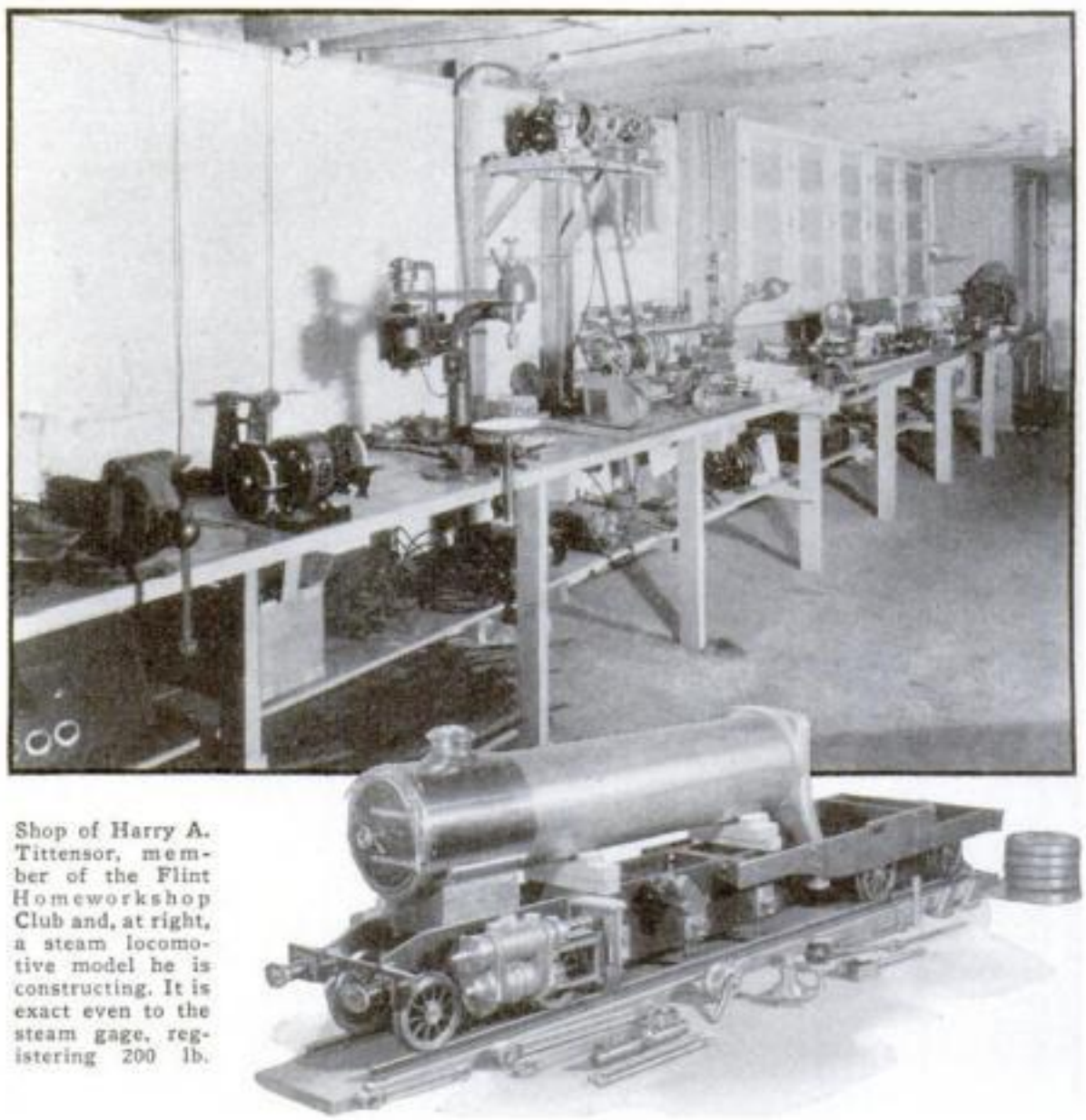
To make the modernistic holdback, cut a circle, an equilateral triangle, and a trapezium of the dimensions shown from thin wood. Glue the trapezium to the triangle and the spool to the circle. The length of the spool or reel may vary with the heaviness of the curtains. Make a hole and countersink it in the center of the circle for the screw. Before fastening the two parts of the holdback together, varnish the circle with dark color varnish, the triangle with clear varnish, and the trapezium with a mixture of the two. For the spool, use whatever shade most nearly matches the woodwork of the room. Fasten the circle and the spool to the window casing with the screw, then glue the other part of the holdback to the circle.

For the pattern of the second holdback, lay off a 5-in. square divided into 1-in. squares, then mark out the shapes of the patterns as shown. After cutting the seven pieces from the wood, make a countersunk hole for the screw towards one end of the strip; then glue the bird, the flower, and two of the leaves to the strip. The leaf at the end should be left free until the holdback is fastened to the window casing so that it may be glued over the head of the screw to conceal it. Glue the small center to the flower, and glue the spool under the hole in the strip.

Enamel the holdback with colors that will harmonize with the colors in the room. The bluebird pictured is bright blue with brick red on his breast and grayish white underneath. The branch is very dark brown, the strip medium brown, the leaves a soft shade of green, and the flower white. Many other colors are possible; for instance, the bird might be painted as a scarlet tanager with a black wing and tail, or as a goldfinch—yellow with a black cap, black tail, and a black wing with two black bars across it. Reverse the design for the holdback at the other side of the window by turning all of the pieces over.—HAZEL F. SHOWALTER.

HOMEWORKSHOP GUILD PRIZE CONTEST

(Continued from page 79)



Shop of Harry A. Tittensor, member of the Flint Homeworkshop Club and, at right, a steam locomotive model he is constructing. It is exact even to the steam gage, registering 200 lb.

truly representative of the Guild work.

All the prizes so far referred to are for the individual work of club members. In addition, there will be prizes and trophies for which the clubs themselves will compete as units. These will be for club projects constructed by a group of members, for the best records in community work or other activities undertaken by the clubs, or for whatever type of accomplishment the Contest Committee decides will give the fairest basis for comparison among all the clubs, large and small alike.

The details of the contest, as they are worked out, will be published in POPULAR SCIENCE MONTHLY, and the rules and regulations will appear in the monthly Guild bulletins. So that clubs can hold their own exhibitions first, the contest will not close until some time late next winter, probably in March.

All these prizes are separate from, and in addition to, the previously announced POPULAR SCIENCE MONTHLY silver medals. These medals, one of which was illustrated in the August issue, are to be donated to the clubs for them to award under their own rules and regulations at their annual exhibitions to craftsmen who display the best work. Each club, provided it has a membership of twenty or more, is entitled to one of the medals. Application should be made on a form which will be sent to the club secretaries this fall.

The Eugene Craftsman Guild of Eugene, Ore., which has been growing rapidly since it was organized in the Eugene High School last March, has several active women members. At a recent exhibition night, Miss Laura Stillman displayed several pieces of pottery and weaving; Miss Hazel Fishwood, pieces of pottery, a pillow, and a hand-woven table runner; Mrs. Raymond Torrey, hand-painted china; Mrs. Corrine Carpenter, a handmade signet ring formed from a flat piece of silver; Mrs. Ralph Pierce, weaving; and Miss Frances E. Baker, hand-tooled leather work. The men were also well represented with handicraft. Among the most interesting pieces were various woodworking shaper and sticker knives made by Clarence N. Crocker, a lamp of maple-wood burl with a veneered shade by H. M. Davenport, a ship's cask made from metal by O. N. Mickelson, a picture frame with 1,622 pieces of wood by Martin F. Johnson, jig-saw work by W. B. Lee, a rug woven on a handmade loom by Albert Kaufman, and a metal die for the club's letterhead made by Talbert Preuit.

Miss Baker is one of the governors of the Eugene Club, Miss Stillman is the librarian, and Mrs. Pierce is a member of the program committee.

One meeting of the club was held in the shop of Mr. Davenport, where he gave a demonstration on wood turning and displayed a whole roomful of turned novelties, made for the most part from Oregon myrtle. At another meeting, W. I. King, president of the club, described Indian methods of making bows and arrows and displayed his collection of antique guns and other relics.

NO MORE enthusiastic group of amateur craftsmen could be found than the members of the Flint Homeworkshop Club of Flint, Mich. They form a nucleus about which it is expected to build up a large organization this fall, according to W. E. Tookey, the corresponding secretary. The club is fortunate in having as one of its charter members Harry A. Tittensor, who is connected with a *(Continued on page 97)*

GUILD PRIZE CONTEST

(Continued from page 96)

large spark plug company. One of the accompanying photographs is a general view of his shop, and another shows a 1-in. scale English-type tank locomotive he is now building.

The Wood-Ridge Homeworkshop Club of Wood-Ridge, N. J., has constructed a complete set of stage scenery for a presentation by the Community Club of Wood-Ridge and has also completed several woodworking projects for use in one of the local schools. Working on a production basis, the club completed all the parts for fifteen three-legged drop-leaf tables. The club recently gave an informal exhibition in a window of a large Passaic, N. J., hardware company.

FOR its summer outing, the Bristol Homeworkshop Club of Bristol, Conn., visited the beautiful camp of Dr. J. Seward Wilson, secretary of the club. Six other members of the club have their own camps where other outings may be arranged. Dr. Wilson would like to see all the clubs in a district get together at least once a year, preferably by having an outing at some centrally located camp.

A surprise in the form of an amusing playlet was put on at one of the summer meetings of the Home Workshop Club of Cleveland, Ohio. This meeting was held at the Lighting Institute Building of the General Electric Company, which staged the playlet. Before it was given, the members were taken on a tour of Nela Park, during the course of which they listened to an engineering talk on shop lighting. Another summer feature of the club program was a picnic.

One of the features of the summer program of the Tuscon Homeworkshop Guild of Tucson, Ariz., was a model power boat contest and exhibition.

A demonstration on the making of aluminum castings in the home workshop was recently given before the members of the Janesville Homeworkshop Club of Janesville, Wisc. The club participated in the 1934 hobby show held at the Janesville Y. M. C. A.

Besides planning for a summer outing, the Elizabeth Homeworkshop Guild of Elizabeth, N. J., has been repairing broken toys during the summer months for distribution to needy children at Christmas.

In spite of the fact that most clubs have suspended regular meetings for the summer, five new clubs have been organized and granted charters. They are the Bristol Homeworkshop Club of Bristol, Tenn., the Capitol Homecraft Club of Washington, D. C., the Elmhurst Homeworkshop Club of Elmhurst, Ill., the Gainesville Homecraft Club of Gainesville, Fla., and the Manchester Homeworkshop Guild of North Manchester, Ind. These are in addition to the clubs listed in previous issues.

As the official magazine of the National Homeworkshop Guild, POPULAR SCIENCE MONTHLY publishes all news of the Guild. For further information about the Guild, fill out the following coupon.

National Homeworkshop Guild
c/o Popular Science Monthly
381 Fourth Avenue, New York, N. Y.

I am interested in the home workshop club idea and wish to know what the National Homeworkshop Guild will do for me. Please send me this information in the large self-addressed and stamped envelope I am inclosing.

Name .....

Address .....

City ..... State .....

(Please print very clearly)

HIGH-SPEED PHOTO PRINTING MACHINE

(Continued from page 90)

should be screwed to the top of the front section of platen with the hinge pin over its center. Screw the free strap hinge to the board adjoining the back edge of the platen in such a position that this pin will be 3¾ in.beyond the back platen hinges. This forms a lever for lifting the platen when operated by a treadle.

If the printer is to be operated by foot power, provide a treadle of very heavy galvanized iron, 9 by 14 in. in size after the ends have been turned down 1¼ in. at each side. A ½-in. galvanized iron pipe should be run through the turned-down ends about 3 in. from the front of treadle, and brazed firmly to each end to keep the treadle from giving way under the pressure of the operator's foot. The front end of the flange on the underside should be tapered off to give clearance, allowing the flange to decrease to ½ in. in width at the front.

THE pipe bearing extends through a hardwood board fastened between the front and back legs on each side of the printer at the floor. Drill a hole through the pipe just outside the board, place a washer over the end of the pipe, and thrust a cotter pin through the hole.

A push-rod is supplied by a piece of ¼-in. pipe with the ends heated, flattened, and drilled to connect between the treadle and the rocker arm that operates the platen. The rocker arm is formed from a piece of 1 by ⅛ in. steel bent to an angle of 135 deg. at each end, so that the two ends are at right angles to each other. One end of the rocker arm is drilled to take a bolt, connecting the rocker to the push rod, while the other end is cut out to form a fork with about 3/16-in. clearance when operating the lever that lifts the platen. This clearance allows an automatic mercury switch to operate after the platen descends, making an electrical contact and breaking the contact again before the platen is raised.

Through the center of this piece is fitted an axle of ⅜-in. steel at an angle of 45 deg., which will make the axle parallel to the forked end, and at right angles to the end which connects with the push rod.

Bearings for the rocker arm are bent from very heavy galvanized iron as illustrated.

If desired, the printer may be constructed without any cabinet above the table; however one may be built at very little expense and work. Plywood is used for the back, and the ends and top are made from 1 by 10 in. wood.

The work light is made by running a piece of ¼-in. pipe up the right end of the cabinet from the junction box, with an elbow and short length of pipe, finished with a brass lamp socket, shade holder, and reflector. The length of the horizontal arm—that is, the distance of the light from the right side of the cabinet—is optional. Bend a strap of iron around the pipe and screw it to the end of the cabinet just below the elbow to form a bearing, allowing the light to swing out of the cabinet when needed. You will find it convenient to turn the reflector up at an angle to give you indirect light on the worktable and allow easy inspection of the paper on the shelves by direct light.

IT WILL also be desirable to have a resistance in the circuit for dimming the printer light when working on thin negatives. This is supplied by running a second piece of ¼-in. pipe from the junction box to the top of the cabinet, boring a hole sufficiently large to take the cap of a standard brass socket, and fitting beneath the top board a small strap of iron drilled to take the pipe, so that this socket may rest on the strap and fit snugly in the hole in the board. This socket will carry a 500-watt heater element. However, it will emit very little heat. It is wired in series with the 250-watt printer light. A switch is also provided to shunt across the wires leading to this resistance, permitting the printer light to burn at full strength. The exposure ratio of full strength to dimmed light should be about one to four. Little visual difference is apparent, but the dimmed light contains much less blue.

It will be necessary to guard this resistance with a well-ventilated shield or basket like that illustrated.

Two snap switches are provided just to the right of the printer head, the first one to control all current to the machine and the second being a shunt switch which cuts out the resistance and allows the light to operate on full capacity when in the "on" position, or dim when in "off" position.

A mercury-tube switch is placed on the right rear leg of the machine and is operated by the push rod, automatically turning on the light when the treadle is pressed. These mercury tubes may be obtained from electrical supply houses and often from manufacturers of automatic furnaces. They come in a variety of forms. If the simple tube is obtained it will be necessary to mount it with one end of the mount weighted sufficiently to cause it to tilt and break the circuit quickly when released. Use a weight and not a spring, as the latter will give too violent a jar if the bearing should stick.

This mercury switch should be inclosed like all other electrical apparatus, so as to meet with the approval of the electrical inspector. A simple junction box is suggested for this purpose. Buy one of the rectangular type with knockout holes for the conduit entrances. One of these holes is used for the entrance from the main junction box. Run a piece of BX cable to the switch box. Knock out one of the lower holes to allow an L-shaped piece of steel to be clamped firmly to the push rod. It extends through the hole in such a position that when the push rod rises to close platen, the switch arm rises with it to tilt the tube.

THE pilot light should be 10 watts, red; the work light, 10 watts, yellow; the printer light should be a G-30 floodlight, 250 watts; and the heater element should be 500 watts. A 100-watt printer light will work very well, though it will, of course, be slower and should be used with a correspondingly smaller resistance—about 200 watts.

If you desire less difference between full and dim light, use a larger capacity resistance; if more difference, a smaller capacity, in watts.

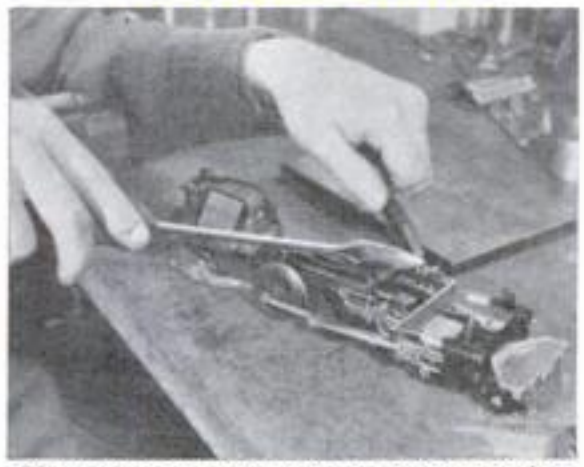
A complete wiring diagram will not be necessary. Run a pair of wires from each of the three switches, from the resistance, and from each of the three lights; and run a heavy, flexible supply cord from outside to the junction box, making eight pairs of wires entering the box. A detailed diagram is given for splicing these wires so that there will be only five points of junction for all sixteen wires. Solder these junctions, covering them first with rubber tape and then friction tape. Then cover the box and screw the lamps in place.

The price of materials will vary to some extent according to your location. The printer constructed by the writer cost about $15. Many corners may be cut and savings effected, if desired; in fact the machine may be hand operated. A simple snap switch may even be used to replace the mercury switch, though the latter should not cost more than 50 cents and there is nothing better.

A medium shade of gray has been found a satisfactory color as it avoids glare. The printer head should be black and glossy; the inside of lamp house, flat white.

MODEL LOCOMOTIVES

(Continued from page 81)



Many hours of work go into the construction of an elaborate locomotive chassis like this

supply. Considering the small quantities in which these parts are fabricated, the prices are quite reasonable, but you mustn't expect them to be as low as similar small articles made on a mass production scale.

It must be obvious that a definite figure for the cost of a locomotive cannot be set without knowing how much of the work you can do yourself. The cash outlay may be virtually nothing if you have lots of scrap material, plenty of ingenuity, mechanical ability, and spare time.

As an example of how the job may be worked out at little cost, Carl F. H. Schrader, of Yonkers, N. Y., built the model illustrated by the ingenious use of odds and ends. He sends this description of it:

"The photo and sketch show what has been done in the way of building an 'O' gage semi-toy locomotive with a toy clockwork motor and wheels from the toy trains for sale in the five-and-ten-cent stores. Only simple hand tools found in any home workshop were used.

"The model is a Pennsylvania E-6 Atlantic locomotive. The boiler tube is a 1¾-in. outside diameter brass tube split at the bottom to contain the clockwork motor. It extends clear back to facilitate lining up the cab. Side rods and valve gear were cut from 1/16-in. sheet brass and filed to shape. The tender has ¼-in. wood floor and deck. The sides and back are a continuous strip of galvanized sheet iron wrapped around. The cylinders, cab, and so on are copper sheet, shaped and soldered. To avoid purchasing castings, many parts were built up with solder and filed to shape."

While few model railway enthusiasts are interested in clockwork models, the methods described could be applied equally well to an electrically driven type.

Assuming that you have some kind of a camera available and you live within striking distance of a railroad station or railroad yard, you will find it interesting to work out your own model drawings by taking several pictures of the locomotive you wish to model, including at least one directly from the side and another squarely from the front. Then use these photographs to prepare a sketch.

With the aid of a magnifying glass and a pair of dividers, you can obtain from the photographs the relative sizes of all important details with sufficient accuracy for model-making purposes. You will be surprised at how many of the small details you can omit entirely without impairing the realism of your model.

Truck wheels, as Mr. Schrader points out, are easily obtained, but the home manufacture of spoked locomotive driving wheels is quite a problem. A set of driving wheel castings may be bought for about 40 cents each if you have a lathe, or in pairs completely machined on axles if you haven't. In that form they cost about $2.50 a pair.

Nor is it worth while to make the electric motor. Powerful small motors that will fit into the space available can be bought quite reasonably.

Selected BLUEPRINTS

For Your Home Workshop

TO AID you in your home workshop, POPULAR SCIENCE MONTHLY offers blueprints with working drawings of a number of well-tested projects. The blueprints are 15 by 22 in. and are sold for 25 cents a single sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by photographically illustrated instructions which supplement the drawings. If you do not wish this supplement, omit the letter "R" from your order and deduct 25 cents from the price given. The instructions alone are sold for 25 cents each.

Many other blueprints are available. Send a stamped and addressed envelope for a complete list.

FLYING AIRPLANE MODELS

Bremen (Junkers, 3-ft.), *89-90*	$ .50
Nieuport XVII, 29-in., *180-181*	.50
S. E. 5a World War Plane, 30-in., *168-169*	.50
Winnie Mae 4-ft., *141-142-143*	.75

BOATS

*Canoe, 16-ft. Canvas Covered Kayak, with sail, etc., *192-193-194-R*	1.00
*Duck Boat, Folding, *170-R*	.50
*Outboard Racer, 11½-ft., 156 lb., *128-129-R*	.75
*Outboard Racer, 10½-ft., 114 lb., *211-212-R*	.75
*Sailboat-Motorboat, Combination (15 ft., cat rig), *131-132-133-R*	1.00
Marconi Rig with Jib for Above, *133A*	.25
*13-ft. Rowboat-Motorboat, *147-R*	.50
*14½-ft. Rowboat-Motorboat, *148-R*	.50
*16-ft. Rowboat-Motorboat, *149-R*	.50
Stern Drive Installation (when used with rowboat-motorboat), *150*	.25
*15½-ft. Runabout or "Sportboat" (outboard or inboard motor), *175-176-177-R*	1.00
*13-ft. Utility Rowboat (can be sailed or used with outboard motor), *224-R*	.50

NOTE: Full-size patterns for any boat marked with an asterisk (*) will be drawn to order for $1.50 extra. Simply add this amount to the cost of the blueprints. About one week is required to fill orders for patterns.

FURNITURE

Bookshelf and Book Ends, Modernistic, *100*	.25
Chests, Treasure, *78*	.25
Lamps, Modernistic, *93*	.25
Mirror, Scroll Frame, *105*	.25
Pier Cabinet and Corner Shelves, *77*	.25
Screens, Modernistic Folding, *91*	.25
Sewing Cabinets, Two, *31*	.25
Table, Tavern, *105*	.25
Table, Tilt-Top, Oak (top 20 by 24 in.) *140*	.25

RADIO SETS

All-Wave Portable (battery), *217-R*	.50
Amateur Short Wave Receiver, *155*	.25
Amateur Radio Transmitter, *183-184*	.50
Amplifier, Three-Stage Audio-Frequency, *42*	.25
Five-Tube Short Wave (A.C. or D.C.) *223*	.25
Full Electric Headphone Set, *130*	.25
One Tube (battery operated), *103*	.25
Screen-Grid Set, *109*	.25
Short-Wave Converter Unit, *137*	.25

SHIP AND COACH MODELS

{Construction kits are available for some of these models. See page 88}

Aircraft Carrier—U. S. S. *Saratoga* (18-in.) and flush deck destroyer (6¼-in.), *226-227-R*	.75
Bark, Scenic, Half-Model (13½-in.), *108*	.25
Battleship—U. S. S. *Texas* (3-ft. hull), *197-198-199-200*	1.00
Bottle, Clipper Ship in, *121-122*	.50
Clipper Ship (20½-in. hull), *51-52-53-R*	1.00
Clipper, Simplified (9½-in. hull), *219*	.25
Constitution (21-in. hull), *57-58-59-R*	1.00
Cruiser *Indianapolis* (12 in. long), *216*	.25
Destroyer—U. S. S. *Preston* (31½-in. hull), *125-126-127-R*	1.00
Galleon *Revenge* (25-in.), *206-207-208-209*	1.00
Hartford, Farragut's Flagship (33½-in. hull), special prints *221-222-R*	1.50
Mayflower (17½-in. hull), *83-84-85-R*	1.00
Motorboat, 29-in. Cruiser, *63-64-R*	.75
Motorboat, Working Model (20-in.), *196*	.25
Liner—*Aquitania* (9-in. balsa wood model made very simply in layers), *225-R*	.50
Liner—*Manhattan* (12 in. long), *204*	.25
Liner—*St. Louis* (11-in.) *231*	.25
Pirate Galley or Felucca (20-in.), *44-45-R*	.75
Roman Galley (19-in.), *138-139-R*	.75
Santa Maria (18-in. hull), *74-75-76-R*	1.00
Schooner—*Bluenose* (17½-in.), *110-111-112-R*	1.00
Stagecoach with horses, *144-145-146-R*	1.00
Steamboat, Mississippi (19½-in.), *94-95-96-R*	1.00
Viking Ship (20½-in.), *61-62-R*	.75
Weather Vane, Ship Model (30-in.), *66*	.25
Whaler—*Wanderer* (20½-in.), *151 to 154*	1.00
Yacht *Sea Scout* (42-in. racing), *106-107-R*	.75
Yacht (20-in. racing), *48-R*	.50

MISCELLANEOUS

Doll's House, Colonial, *72*	.25
Log Cabin (three rooms), *134-R*	.50
Microscope Kit, Portable, *220*	.25
Toy Drill Press, Lathe, Saw, etc., *113*	.25
Toy Dump Truck, Fire Engine, etc., *101*	.25

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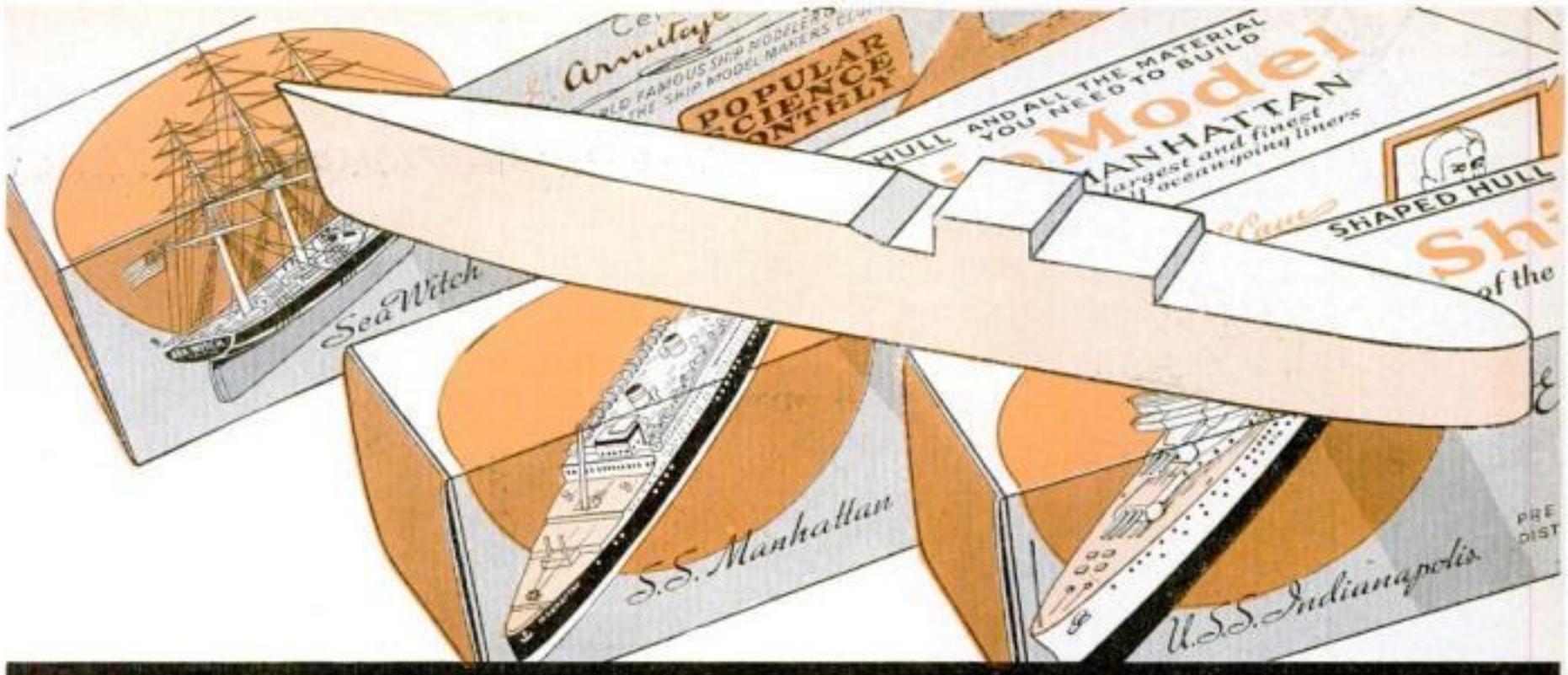
Please print your name and address clearly.

Racing Yacht MODELS

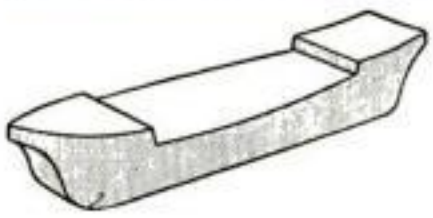
YACHTING is in the air these days. Only a millionaire can build a cup defender or challenger, but anyone can make a speedy little sailing yacht model and get a real thrill out of racing it. We have blueprints for two particularly fast models. One is an easily made 20-in. yacht designed by Capt. E. Armitage McCann (Blueprint No. 48-R, price 50 cents). The other is an advanced 42-in. yacht (Blueprints No. 106-107-R, price 75 cents).

Captain McCann with the fast 20-in. yacht he designed for No. 48-R in our blueprint series



BUILD YOUR OWN SHIP MODEL

With These New, Improved, Simplified Shaped-Hull Kits



Sugar pine shaped hull—main cuts already made. Easy to finish. Top printed for location of masts, deck houses, etc.

Clipper Ship "Sea Witch" **$1.50** Postpaid

13 inches long—8 inches high. Famous and beautiful American Clipper. Kit contains every part needed including blue print, and pamphlet of instructions. Top deck of shaped hull stamped for location of masts, houses, etc. Kit contains paints, glue, chain, deadeyes, anchors, flags, printed bow and stern name plates. $1.50 delivered.

Almost wholly shaped hull of soft sugar pine with all main cuts already made, easy to finish.

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Complete Kit for 12 inch model of the famous cruiser from which Pres. Roosevelt viewed the fleet. An excellent, graceful, racy model, easy to make with simple hand tools. Kit contains everything needed including paints, glue, anchors, propellers, rudder, blue print, pamphlet of step-by-step instructions, etc. $1.50 postpaid.

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A SPEEDY RACING SCHOONER

(Continued from page 87)

cated on the deck beams, and the center line on the deck board coincide. Use only enough screws to hold the hull straight. Do not glue.

Place the hull on the bench bottom up. Smooth off the inside stem flush with the end of the keel. Spring a ⅛-in. board to one side of the bottom to get the feel of the bend. You will notice that it curves at the keel and will have to be cut on a curve. Mark around the outside of the hull while the board is held in place. Trim this board until about ¼ in. wider than the line shows. Put plenty of glue on the ribs, edges of the sides, and at the keel. Hold the board at the stern with ½-in. screws with washers under them and at the ribs with pins driven through. At the bow, screws will be needed. When in place, trim the bottom board along the center of the keel. Fit on the other side of the bottom as before, trimming the two sides together at the keel. This task requires more care than any other in building the boat.

PAINT the inside of the boat at the corners, ribs, and keel liberally with the cement. Now make mast steps and insert them in their proper places. Square off the front end of the boat and glue on the other 5 in. of the stem piece. Hold in place with a pin or two while the glue is drying.

The masts are made from ½-in. square stock, planed to a square taper of ¼ in. at the top and 7/16 in. at the bottom. Plane off the corners until eight-sided. Next, plane off these corners, one shaving at a time, while rotating the mast, and continue until it is practically round. The masts should taper from 7/16 to 3/16 in. The mainmast is about 26 in. long, and the foremast about 22 in.

Make the spars similarly. The main boom and fore boom taper from about 5/16 to ⅛ in., and jib boom and gaffs are slightly smaller. Finish these with coarse sandpaper and smooth with fine. They are given three coats of spar varnish, polished with steel wool between coats. Finally rub them with steel wool, and polish with a good floor wax. The bowsprit is 6½ in. long, tapering from ⅜ to ¼ in. The part that is to lie on the deck is planed flat on that side.

By the time the spars are made, the glue on the hull should be dry. Remove all pins and screws. Whittle pegs, dip in glue, drive them in the screw holes, and break them off. Sandpaper the bottom smooth, including the bottom of the outside stem piece. Fit the keel. Remove the center deck board and drill holes through the inside keel for screws. Fasten the outside keel in place with glue and screws from the inside. Replace the center deck board with glue. Mark and cut the mast holes, fitting the masts in place. Cut off the tops so that the foremast is exactly 18 in. above the deck, and the mainmast 22 in. Take out the masts and glue on the rest of the deck with plenty of cement. Hold temporarily with pins. With a sharp knife trim off the edges of the bottom, and smooth up. Fill any cracks around the keel with wood putty composition or with some wood dust mixed with cement and acetone.

Trim the sides of the deck and the outside stem, and sandpaper the completed hull smooth. Cut the rudder out of ¼-in. wood; bore two small holes clear through and drive in brads. File the brad ends off, and the rudder is reënforced so that it cannot split.

As a pattern for casting the keel, use the piece of ½-in. wood cut off for this purpose. The keel may be cast in sand, or a mold may be formed by tacking two pieces of wood to a ½-in. strip so that they come above the edge exactly even with the pattern of the lead keel. Tack a block in the back end, and at the front put in a lump of plastic wood. After oiling the pattern, push it into this boxlike mold; then remove it. This shapes the wood putty to match the front of the keel. At places where screws will be needed, drive into the form 10-penny wire nails that have been smoked in a candle flame until very sooty. Drive deep enough to stand alone. Place the form in the vise, leveling the top edge. Pour it full of molten lead, being careful not to spill any or a bad burn may result. When cool, remove from the form and work the nails out. The keel should weigh about 3 lb. If more than that, file off some. Screw the lead to the bottom of the keel, fill any cracks with wood putty, and paint the hull.

The jib boom is fastened to the bowsprit with two screw eyes. One is screwed into the bowsprit; the other is opened, hooked into the first, closed up, and screwed into the jib boom. Always bore a hole in spars before putting in a screw eye. The same procedure holds for the fore and main booms. The gaffs are rigged by drilling two holes and lacing in a piece of No. 20 wire to make a ring on the end. The end is then wrapped with thread, which is glued to hold it securely.

THE tiller is made from wood ¼ by ½ by 6 in., tapered as shown. Two inches from one end a slot is cut for the rudder, which is held in place by two brass pins passing through the tiller and rudder. The ends are cut off, a daub of glue applied, and a screw eye put in each end.

Make a cradle for the boat and set her in it. Put on the bowsprit with two screws and glue. Insert the masts and drop seven rings on the foremast and nine on the mainmast. Put on the gaffs. Screw eyes are inserted in the tops of the masts. Wrap the tops with thread and apply glue. Put the screw eyes in the booms as shown, and two screw eyes in the deck on each side of each mast, the first ½ in. back of the mast at the deck and the second 2 in. back of the mast. At the bow about ½ in. above the keel insert another last screw eye. Rig the ship with No. 3 cord from the bow screw eye, up over the end of the bowsprit to the top of the foremast and across to the mainmast. Make sure the masts are still as far apart at the top as at the deck. Tie in the side stays on the foremast first, then on the main.

Cut the sails from light cloth. Many have trouble here. My favorite method is as follows: A piece of wrapping paper is cut ⅛ in. oversize one way. *(Continued on page 103)*

List of Materials

No. of Pieces	Description	T.	W.	L.
4	Sides and bottom	⅛	3¾	24
1	Lower ribs	¼	3½	24
	Inside keel and deck beams	¾	¾	70
2	Spars	½	½	30
2	Spars	⅜	⅜	24
1	Keel	¼	3½	24
1	Inside and outside stem	⅝	⅝	10
3	Deck	⅛	2	24

30 small galvanized screw eyes.
2 small screw hooks.
10 small brass curtain rings for mast rings.
1 paper brass pins.
½ oz. 1½-in. No. 20 brass escutcheon pins.
Screws for keel and bowsprit.
White fishline about No. 3 cord size for rigging.
About 1 ft. No. 20 bare copper or brass wire.
2 bicycle spokes or brass rod of same size for travelers.
NOTE: All dimensions are given in inches.

A RACING SCHOONER

(Continued from page 102)

The cloth is cut to this pattern ¼ in. oversize all around. Use the selvage edge at the leech (after edge). The pattern is then sewed to the cloth, except the selvage side. The overlapping edge is folded over the paper, and the sail goes through the sewing machine again. Make one more fold, this time turning over the edge of the paper, and run the sail through the machine twice around three sides. Tear away the paper, and a sail with a neatly hemmed edge on three sides is left. This prevents any distortion of shape by hemming.

The sails are fastened to their respective spars at their corners and pulled tight, then held in between with a simple lacing from tip to tip. When fast to boom and gaff, the hoist lines are tied in. Then the mast rings are sewed on.

The three travelers are sections of bicycle spokes or brass rod of the same size, bent as shown to fit the deck. They extend to within ¼ in. of each side. A ring is put on two of them, and they are driven into the deck over a deck beam. The third or after traveler has no ring and goes over the tiller. Hang the rudder on two pintles, one at top and one at bottom, as shown.

THE sheet lines and rudder rigs now go on. A line is tied to the outboard end of the tiller, passed through a screw eye in the end of the boom, thence through a toggle, thence through the screw eye in the other end of the boom that is locked into the eye in the mast, back through the toggle, and tied. These toggles are made of pieces of toothbrush handles cut with a hack saw to approximately 1/16 by ⅛ by ½ in. Two holes are drilled with a pin drill the size of the cords. When moved backward or forward, the toggles hold the sheet wherever it is set.

The other booms are controlled in a similar way except that the sheet line is tied to the traveler ring.

The arrangement of the rudder tension is illustrated. There is a screw eye in the mainmast and another in the deck; and a line from an elastic band is toggled here so that the tension may be adjusted by the toggle. When the wind hits the mainsail, the rudder is pulled to steer the boat away from the wind instead of letting her jump into the wind. Adjustment of the tiller tension will give you the right control of the boat.

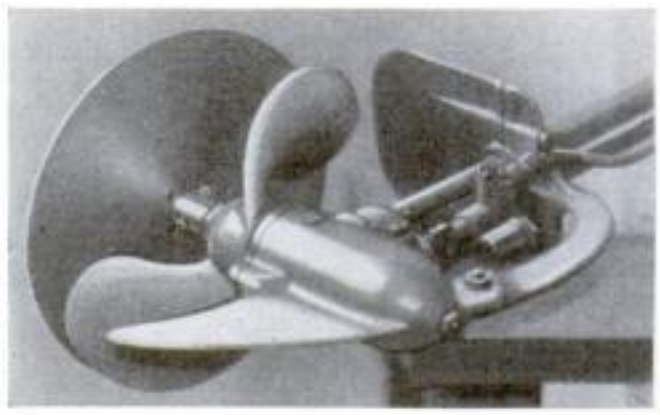
You can learn much about sailing with a rig like this if you will stake out three buoys on a small pond and then try to sail this boat around the course. In fact, with three or four boats you can run real races since you can follow around the edge of the pond and readjust the sails each time the boat touches, thereby continuing the circuit of the course. Thus you get experience in sailing in all directions regardless of the wind.

Mr. Waldron has built many models of yachts, motorboats, and other vessels by the same general methods. If you would be interested in additional articles by him describing more advanced models, please write to the Home Workshop Editor and mention what type of model you would prefer to build.

TIRE TAPE FOR BINDING

ORDINARY tire tape makes a serviceable substitute for *passe partout* picture binding strips, and it will outlast the regular type. Apply the tape as if it were the ordinary type of binding; then run a hot soldering iron over it, which will stick it tightly and permanently. It may then be trimmed with a razor blade. To do away with the stickiness, dust the tape freely with talc, rub it in well, and brush off the excess.—ARTHUR L. FORD.

Disk Reduces Motorboat Speed *for* Trolling



A circular metal plate, attached to the propeller shaft as shown in the drawing, serves to reduce the speed of an outboard motorboat

BY ATTACHING a circular metal plate to an outboard motor as shown, it is possible to troll at speeds of from ½ to 2 M.P.H. The propeller turns as fast as usual, but the plate immediately behind the propeller greatly reduces boat speed. Cooling is not impaired. Any light twin, or even the larger motors, may be equipped in this way. It takes only a couple of minutes to attach or remove the device.

The plate is 1/16 in. thick by 7¼ in. in diameter. Aluminum, sheet iron, or brass, purchasable at any junk yard, is satisfactory. The flange is a model-T Ford spindle body bushing, which costs about ten cents.

As outboard motor propeller shafts vary in diameter, the bushing must be drilled and tapped to fit. Some shafts may be smaller than the bushing hole, in which case it may be necessary to weld the bushing shut and redrill and tap it to the required size. The plate is then drilled to receive the bushing, and four 3/32-in. diameter holes are drilled in the flange and plate for rivets. Nails cut to size will serve as rivets. To prevent the plate from vibrating loose from the shaft, drill a 3/32-in. hole through the bushing and insert a cotter pin.—W. J.

REMOTE CONTROL FOR WATER HEATER

OWNERS of water heaters located in the cellar have, without a doubt, often longed for a simple method of remote control to turn the heater on or off. The heat control motor and clock time switch described in previous issues (P.S.M., Feb. '34, p. 74, and Mar., p. 90) will provide the essential parts.

The control station consists of an ordinary alarm clock fitted with a contact system attached to the "alarm" wind key exactly as described in the March issue. Somewhere on the clock should be mounted a small three-point transfer switch (radio type).

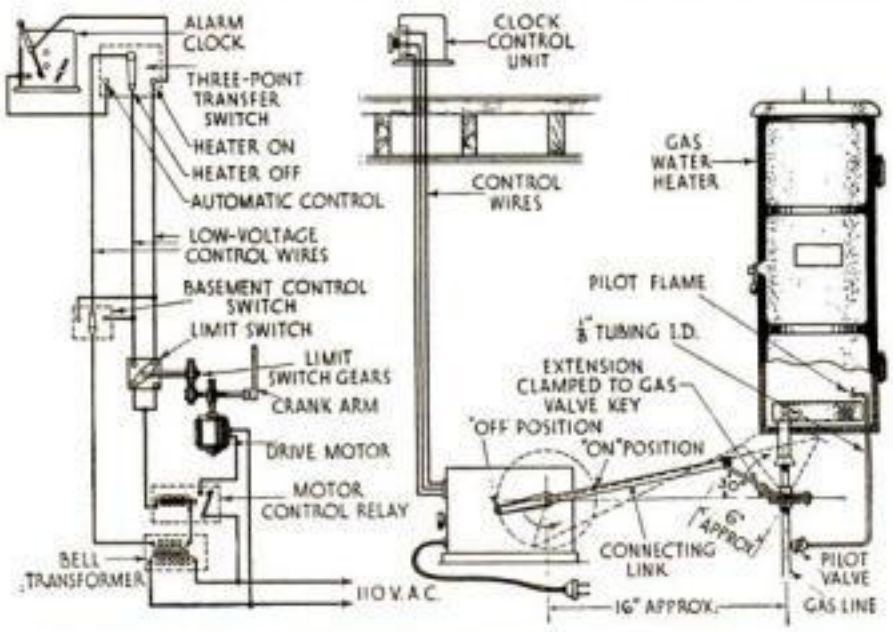
The heat control motor unit is used to operate the gas valve. The motion of the crank on this motor is a half revolution per operation. This action is used in conjunction with a simple link mechanism to cause the gas valve to open and close. Mount the motor unit on a rigid base near the water heater. The center of the motor crank and the gas valve key should be in the same horizontal plane.

The small pilot flame may be constructed of a piece of ⅛-in. inside diameter metal tubing and a small valve. The valve is installed on the main gas line just before the heater valve. Regular pipe fittings may be used, although a tapped hole in the gas pipe at this point will serve to mount this small valve. Bend the metal tubing so that it points at the top of the main gas burner. Flatten the end of the tubing to provide a long, flat flame.

As previously explained, there should be three points on the switch mounted at the clock unit. When the rotating blade of this switch makes contact with the first of these, the motor will operate in a direction to turn the valve on. Contact with the second point will cause the valve to close. The third point on the switch provides the automatic position. The contacts operated by the "alarm" key on the clock are connected in series with this third contact point of the transfer switch. Thus, when the transfer switch is turned to the third position and the "alarm" set for some future time, the circuit remains open till the alarm key starts to unwind and strikes the stationary contact. The control circuit is then energized and causes the motor to open the gas valve. To close the valve, just turn the switch back to the second position.

If the reader has any one of the standard electric heat control systems installed in his home, he can use the motor unit as part of this water heater control. In wiring the motor and clock unit, the common terminal is connected to the transfer switch blade.

It is important, of course, not to turn the pilot flame too low and to keep it under observation. In that case, provided the gas is supplied by a dependable company, the danger of having the gas fail to ignite is remote. However, any heater not provided with an automatic patrol valve must be used with reasonable care and caution.—J. L. Bird.



Not only can the water heater be turned on from upstairs, but it can be operated at any predetermined time by means of the alarm-clock unit

NOVEL THREE-IN-ONE NEST OF TABLES

(Continued from page 85)

tion of the main table is begun by squaring the four legs to dimensions and turning them. They may be reeded as shown or left plain.

The two rails are mortised into the legs. Each tenon should be about ¾ in. long. A recess ½ by 11/16 in. is then cut on the inside surface of each leg. This serves to support the stands. The two supporting braces connect the rails and form a third point of support for each stand. The stretchers are joined to the legs and to each other by means of dowels. The leg ends of the two stretchers are sanded on a ¾-in. spindle sander.

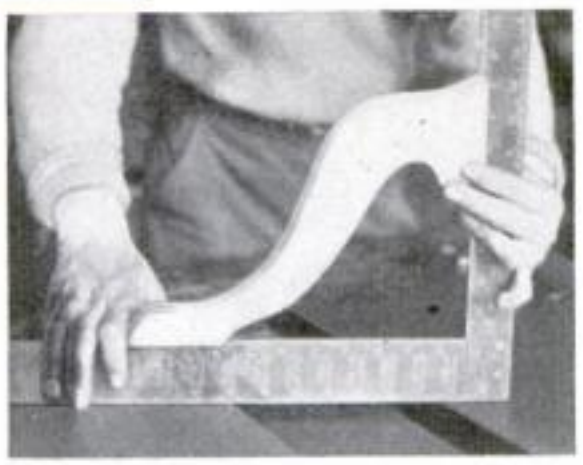
Glue the two sides together first. When these are dry, complete the gluing of the table. See that the two stands slide easily into place and make any necessary adjustments.

Glue up the top from two or more boards. It may be veneered, inlaid, or left plain. The edges should be shaped as shown, either by machine or by hand. The top is fastened to the table with screws through the braces.

List of Materials

No. of Pieces	Description	T.	W.	L.
4	Table legs	1⅜	1⅜	23⅝
2	" rails	¾	2	15¾
2	" stretchers	⅝	1¼	15⅛
2	" "	⅝	1¼	11½
2	" braces	1¾	1½	13
1	" top	⅝	15	30
2	Stand columns	1⅜	1⅜	18
1	" legs (8)	¾	8	20
2	" tops	⅝	12	12
2	" plates	¾	6	6

NOTE: Dimensions are given in inches and are finished sizes.



When the legs have been sanded to fit the columns, they are tested with a steel square

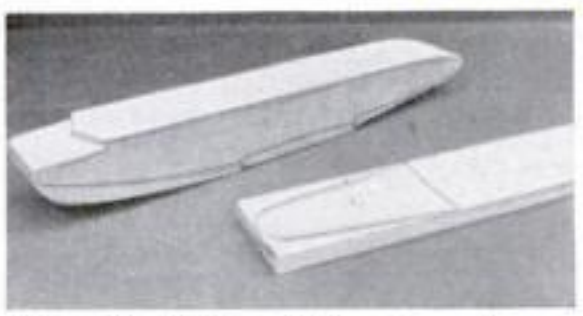
A table of this kind should be made of some close-grained cabinet wood such as mahogany, walnut, gum, birch, or maple. If water stain is to be used, sponge the wood first with water and sandpaper again when dry to prevent the grain from being raised when the water stain is applied. After staining, the work is sanded lightly with No. 3/0 sandpaper, and one or two coats of *very thin* shellac are applied. Each coat of shellac is rubbed down with No. 2/0 steel wool.

Two or three coats of a good grade of rubbing varnish are applied on top of the shellac. Sand lightly between coats and let each coat dry thoroughly before applying the next. Follow the manufacturer's directions as to the drying time. Do the varnishing in a warm, dust-free room and clean the brush thoroughly in turpentine before applying a new coat.

Rub down the final coat with paraffin oil and No. 7/0 waterproof sandpaper wrapped around a felt rubbing pad, or use pumice stone and water. A high luster is obtained by a final rubbing with polishing oil.

LARGEST AMERICAN FLYING BOAT

(Continued from page 73)



Marked hull blank with first stage of carving finished. In foreground, the wing blank

sary to glue together several pieces of wood, preferably soft white pine, to get the right thickness for the hull blank. Casein glue is excellent for this purpose. Plane the blank to the size given, mark the hull profiles on both sides, and cut down to the lines. Next, mark the top plan curves on the top of the blank and cut to these lines. Then round the top of the hull for its entire length, being careful to preserve the shape of the cockpit windows. After shaping the bottom to the proper angles, finish with sandpaper and then cut the strut pockets.

The wing can be made in one piece. Cut the blank to size, mark the profile on both ends, and on the bottom side mark the taper and end curve on each end of wing. Plane to the lines. Next, plane the bottom of the tips to the dihedral angle shown. Now round the top portion of the tips to the proper airfoil, and sandpaper all. If the builder prefers, he can make the tips separate and fasten them on with pins and glue.

The three tail units, which should be made of wood, are easy to make if the drawings are followed. The wing mount and tail mount blocks are equally simple, although they may look somewhat difficult in the drawings. The wing floats can be made by planing a piece long enough for both blanks and then cutting it in two. Follow the same procedure as given for carving the hull.

Make the motor "eggs" of either pine or balsa if they are to be whittled out, but use hardwood if a lathe is at hand. Attach them to the wing with glue. Make the propellers of thin metal.

All of the struts except *E* and *F* (which are wire), should be made of white pine.

The hull, wing, tail, motor "eggs," floats, and struts should be painted aluminum; the bottoms of the hull and floats, and the windows, black; the long panel trim on top of the wing, orange; and the strip on the hull at the water line, red.

The last step in assembling the model is to attach the propellers with roundhead nails

MODEL OF THE OLD LINER *ST. LOUIS*

(Continued from page 77)

List of Materials

BALSA WOOD

No. of Pieces	T.	W.	L.	For
1	1/2	1¾	11	A
1	3/16	½	2	U (20 lifeboats)
1	1/8	1¾	11	C
1	1/8	⅜	4⅜	E*
1	1/8	⅜	1⅜	F*
1	1/8	⅜	¾	G
1	1/8	⅜	1⅛	K
1	1/8	⅜	¾	L*
1	1/8	⅜	⅝	M*
1	1/8	⅜	¼	P*
8	1/8	⅜	⅜	S*
1	1/16	1¾	2¾	B
1	1/16	¾	⅝	N*
1	1/16	¾	1¾	O*
1	1/16	¾	5/16	Q*
1	1/16	3/16	3/16	R
1	1/32	1¾	11	D

FIBER BOARD

1	1/64	1¾	4⅜	H*
1	1/64	1¾	1⅛	I*
1	1/64	1¾	13/16	J
8	1/64	5/32	5/32	T*
2	1/64	¾	¾	V and Z*
1	1/64	¾	3/16	W*
4	1/64	⅜	⅜	X*
1	1/64	½	¾	Y*

MISCELLANEOUS

4 wood dowels, 1/16 in. round by ⅛ in. for X*.

2 wood dowels, ¼ in. round by 1 in., for funnels.

4 pins with heads removed, 1⅝ in. long, for derrick booms*.

2 pins with heads removed, 1 in. long, for topmasts*.

2 pc. heavy wire 2¼ in. long for masts*.

4 pc. fine wire 1 in. long for funnel pipes*.

6 pc. fine wire ⅝ in. long for supports*.

32 pc. fine wire ⅜ in. long for davits.

Black, white, and dark brown paint. Mix brown and white to get buff color.

Cement or glue; sandpaper.

NOTE: Pieces marked with asterisk (*) are ready for final assembly when cut to the given specifications.

ship's counter. The open portion of the hull formed by the indentations in piece *C* can now be painted white. Then paint the sides of the hull black, and the entire top deck buff.

With a very fine needle, drill holes for wire supports and davits into *H* and *I*. Attach *K*, *L*, and *M* to *H*. Make the eight ventilators by gluing the *T* pieces to the *S* pieces, sandpapering a slight bevel on the edges of the *T* pieces. Attach the eight ventilators to *H*. Attach *P* to *K* and *N* to *M*.

Make twenty lifeboats from 3/16 by ½ in. stock. Sandpaper the corners of the stick to shape, mark 3/32-in. spaces along its length, and cut crosswise, as if slicing bread, with a sharp, thin razor. Glue to the positions indicated on *H* and *I*, centering each boat between the holes drilled for the davits.

Glue *H* to *E*, *I* to *F*, *J* to *G*, and *Q* to *J*. Paint the three units thus formed and piece *O*, still unattached, with at least two coats of white. When dry, paint over the tops of *K*, *L*, *M*, *N*, and *Q* with buff.

Glue the three superstructure units to the hull. Insert a fine needle through each of the holes previously drilled in *H* and *I*, and continue through piece *D*, keeping the needle absolutely perpendicular to *D* and making the holes in *D* as near the edge as possible without splitting the wood. Form the davits by bending one end of each of the ⅜-in. pieces of fine wire into a quarter circle. These can be made uniform by bending them around a pencil or dowel about ¼ in. in diameter. Insert the davits and the six ⅝-in. wire supports into the holes already made, and continue pushing them into hull until they take firm hold and are all at the same height. Glue *O* to *K*, the ends just touching the four wire supports previously inserted.

Prepare the funnels by trimming their undersides to the required angle. Paint them black with a ⅛-in. white stripe 3/16 in. from the top. A thin strip of white gummed paper can be used for the stripe to assure a neater job. When dry, glue them to *H*, making

This sketch shows how to shape the hull at the very stern, called the "ship's counter"

certain that the alignment and rake are true. Paint the four 1-in. wires black and insert fore and aft of each funnel to make the pipes.

Paint the four hatch covers *V*, *W*, *Y*, and *Z* dark brown and glue in position on *D*. They are easily located by their relation to the superstructure.

Paint the four derrick booms dark brown and insert two into *E* and two into *M*, keeping them 1/16 in. apart on the center line. Make the masts by cementing the 1-in. pins to the 2¼-in. wires, overlapping them ¼ in. Paint them dark brown, except for about ⅝ in. on the mainmast (the second mast), which is black. This black part begins at the top of the lowermast and continues down ⅝ in. Insert the masts in position between the derrick booms, driving them through previously drilled holes. The masts should go through to the underside of *A* to get full support. If the angle and alignment are not correct, bend the masts at the point where they enter hull. Masts and funnels should be in straight line when seen from the bow, and at the same angle when seen from the side.

Make the four winches by attaching the round wood to the fiber squares. Paint them black and glue two alongside each mast. Push the derrick booms into *M* so that the free ends just reach the mainmast, giving the impression that they are supported by the mast.

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WOULD YOU JOIN A MOB OF LYNCHERS?

(Continued from page 13)

however, she became quiet and her breathing grew deep and regular. Later, she said she felt nothing during the whole operation although examination of the inhaler revealed she had been breathing air without even the smell of anesthetic in it.

Recent researches, here and abroad, have brought out many new facts about the mysterious power of suggestion. They have answered many of our common questions. For example:

At what time of day are we most suggestible? Toward evening when we are tired. At what age is our suggestibility at its peak? When we are eight years old. Are women more suggestible than men? Yes. Are Southern or Northern races more suggestible? Southern races. Is suggestibility the sign of a weak mind? No. Tests have shown that the person with an alert, wide-awake mind is more likely to be suggestible than one with a slow or dull brain.

AMONG the ingenious tests for suggestibility which have been worked out by psychologists are a number of simple ones that you can try on your friends.

One requires the subject being tested to hold a metal bob at the end of a string near a steel bar. He is told the bar is magnetized. If he is suggestible, unconsciously he will move the bob nearer the bar. In another experiment, two boxes, one larger than the other but both weighing the same are lifted by the subject. If he picks the larger box as heavier, he is suggestible. Again, a dozen small boxes of identical size and shape are placed on a table. The first five are progressively heavier, the rest weigh exactly the same. The suggestible person will imagine the later boxes vary in weight because the first five do. Lines of different lengths, appearing in a slit, and cork balls with hardly perceptible variations in weight are also used to detect susceptibility to suggestion.

One of the latest discoveries reported in connection with suggestion was made in an American psychological laboratory. Those whose hearing becomes keener when they are concentrating or in a reverie, the research workers discovered, are of the suggestible type; those who go into a "brown study" and do not hear when spoken to are not.

In a riot, a panic, a mob, or a lynching party, the members cease to think as units. They seem to lose all feeling of individual responsibility. They are swept along, veering from one suggestion to another and, in the end, almost always they are carried farther than they intended to go.

An illustration is the barbarous act of a Missouri mob.

After snatching from the hands of a sheriff, the murderer of a twenty-year-old school teacher, the mob started to hang the prisoner from a tree. Then a member shouted: "Let's hang him in the school yard!" Immediately the crowd took up the cry and surged in that direction. At the schoolhouse, someone else yelled: "Let's put him on the roof and fire the building!" Almost automatically, men rushed for ladders, dragged the victim to the roof, and handcuffed him to the peak. Then they poured gasoline in a great circle around him and touched it off with a match. While hundreds of men, women and children cheered, the fire ate through the roof and plunged the flaming body onto the desks below.

SUCH fiendish acts are almost always impromptu. They are thought of on the spur of the moment, after the suggestibility of the mob has reached the point where ordinary reason has ceased to function and where normal feelings are forgotten. Only on rare occasions do mobs act with the drilled precision of a football team, or carry out programs prepared in advance.

One recent example of the kind, however, occurred in West Virginia. A hundred masked men in motorcars, without licenses, silently circled the county jail late at night, gained admission by pretending they were bringing in a prisoner, and dragged two killers from their cells. Fifteen miles in the country, they strung up both, side by side, from the crossarm of a telephone pole. Then they stepped back and at a word from the leader riddled the bodies with bullets. Before anyone could investigate, the killers had sped away.

MOST mob action has a different story. It begins with a formless group of excited people in a suggestible frame of mind. Gradually a leader emerges, makes suggestions and directs the pent-up violence of the mob toward a given purpose. Almost always, somewhere along the way, there is a psychological moment when the future action of the mob hangs in the balance.

During the Siege of Paris, in the Franco-Prussian War, a famous instance of this sort occurred. Storming the Louvre, where the government was sitting, a mob demanded the immediate execution of a Marshal of the army who, they said, had been caught copying fortification plans to sell to the enemy. Because the Marshal had helped design the fortifications and was most interested in seeing them prove their worth, and because similar plans could be bought in almost any bookstore, government officials knew the charges were absurd. But the orator who saved the prisoner's life made no attempt to reason with the mob.

"Fellow citizens," he declared, "you have done a great, patriotic deed. Your work is over. Let the government conclude your investigation. Justice—pitiless justice—shall be done. In the meantime we will keep the prisoner in custody." The mob cheered, dispersed, and in half an hour the Marshal was able to return safely to his home.

A twist of a different kind marked a lynching in Indiana, a couple of years ago.

Shortly after nine o'clock at night, more than a thousand people had collected about the local jail where three murderers were awaiting trial. Leading citizens made impassioned pleas for law observance. A show of hands indicated that a majority of the crowd favored letting the law take its course.

At that moment, the aged father of one of the victims came from the jail where he had been conferring with the sheriff. As he emerged, those near-by surged toward him. He lost his footing and fell. Immediately, word ran through the crowd that he had collapsed from the shocking details of the crime he had heard inside. Like a match producing an explosion, the idea touched off the mob. In a fury it lynched two of the slayers and was ready to hang the third before State Troopers could get the situation under control.

IN THIS strange realm of suggestibility, psychology has many mysteries yet to solve. Recent researches, however, have gone far to explain how the mob-mind works and why such mass action takes place.

To sum up: Psychology has traced the excesses of a mob to the feeling that the victim is not human but is a devil that must be destroyed. This gives the feeling of moral justification. It has found that in the midst of the mob the individual loses his capacity to reason normally; that he reaches a suggestible state approaching hypnotism. It has learned that, if the conditions are right, mob violence may appear in any town. And, finally, it has discovered that only by avoiding crowds which may become violent can YOU be sure you will not join a mob.

RAISING GOLDFISH BY THE MILLION

(Continued from page 26)

they are several months old. They are olive black like their cousins, the carp. And, curiously enough, just before they turn reddish gold they reach their blackest hue. The coming shift in color seems to drive all the dark pigment to the surface.

Scientists from all over the middle west have spent time making researches in biology at the hatchery. Literally scores of attempts were made to speed up the shift in color so the fish could be placed earlier on the market. The average age of fish leaving Grassyfork is now four months. Hatched in June, they are ready for sale in October.

IN THE experiments, fish were kept in covered tanks, in open tanks, in small tanks and large tanks, in pitch-dark tanks, in sun-rayed tanks; in tanks filled with warm water, with cool water, with water treated with various chemicals. They ate powdered liver and chemicals were introduced into their rations. Nothing did any good. The correct color appeared at Nature's appointed time and not before.

By the end of a year, eighty per cent of the fish have changed color. The rest are usually put back and held for another year. Some never do become goldfish and are sold for bait. Hundreds of thousands are shipped from Martinsville each year. Because they live longer than other minnows, many anglers prefer them. The price runs from a dollar a hundred up.

Fish that can swim around in a thimble when several days old may grow to a length of eight inches in four months under the scientific diet and care at Grassyfork. The average growth is about an inch a month, the fish being three or four inches long when ready for sale.

At the end of the second month, the flour diet is stopped, and the young fish start in on the growing rations, cooked hominy hearts which have been compressed to squeeze out all the oil and then ground to powder. Practically all the feeding is done in the morning. The breeding fish get corn-meal mush, thrown into the water in great chunks. This mush cooks in a boiler that holds three and a half tons and, at some seasons of the year, three boilerfuls a day—21,000 pounds of mush—are needed to supply the breeding ponds. As much as 5,000 pounds have been thrown into a single seven-acre pond at one time.

During the fall and winter, when the fish are semi-dormant, the Grassyfork food bill drops to almost nothing. Occasionally men walk out on the ice and peer down into the ponds. If the fish are moving about, they chop holes in the ice and throw in food; if they are quiet, they leave them alone.

IN 1916, during a heavy freeze, one of the ponds turned to solid ice. A muskrat had burrowed through a levee and pulled down the water level of the pond so it froze to the bottom. More than 100,000 fish were killed. While an occasional goldfish will live after being frozen in solid ice, most specimens are affected if the water nears the freezing point or rises above ninety degrees Fahrenheit. The ideal temperature of water for goldfish is about sixty degrees Fahrenheit.

Harvesting the goldfish is always an exciting time at the hatchery. Men, wading up to their waists in water, drag huge seines through the ponds. They are followed by crews with long scoops who work across the mud of the bottom when the water has been drained away, filling pails with the fish that remain. Hooked to shoulder yokes, these buckets are carried to waiting trucks and hauled to the five ponds that surround the shipping depot. Here, the fish are dumped into screen cages where water, driven by an electric pump, sprays over them to harden them for shipping.

Inside the red-brick shipping depot, men sort the fish, sliding them rapidly over oil-cloth-covered tables into different containers. Later they count them and pack them in special metal cans with compartments overhead for cakes of ice. Only in recent years, have shipments in summer heat been possible. The containers and methods worked out at Grassyfork enable fish to stay alive for eighty hours and arrive in good condition. As many as 283,000 goldfish leave the depot by express on a single working day.

SUPPLEMENTING the express containers is a recent innovation, a "submarine" tank truck, a ten-tired giant that hauls between 60,000 and 110,000 goldfish on every trip to the eastern depot of the hatchery at Saddle River, N. J. Other depots of the company are located at Chicago, Ill., and Hamilton, Ont.

As many as 200,000 fish can ride in the porous metal baskets which are packed in the tank row on row as it is filled with water. When the level inside has risen into the "conning tower" dome, which prevents splashing, there are 1,400 gallons of water within the huge container. At the rear, a three-horsepower gasoline engine drives a compressor, forcing a constant stream of fresh air through the water. Three times, once every fourteen hours, during the trip to Saddle River, the water is changed. The construction of the truck—the only one of its kind in existence—insulates the fish from external heat and cold. Two layers of metal, with a two-inch cork lining between, form the shell of the tank.

Once, last winter, the machine rolled into Saddle River with the thermometer standing at forty degrees below zero. Yet the construction of the tank protected the fish and not one was lost. Over the auxiliary engine, and warmed by its heat, a coil of tubing carries the air into the water during winter months, thus raising its temperature.

The average number of trips for this road giant is forty a year. Oneway runs to the eastern seaboard take from fifty to fifty-four hours and the round trip approximately 120 hours. It can maintain a steady pace of forty miles an hour along concrete roads without jarring or injuring the fish packed inside.

Riding in the tank are eight types of goldfish, the kinds specialized in by the hatchery. They are: common goldfish, long-tailed comets, stubby-bodied Japanese nymphs, red fantails, spotted calico fantails, varicolored shubunkins—no two of which ever have the same pattern of red, black and blue patches on their sides—red telescopes, with their protruding eyes, and black Moor telescopes.

FREAKS—silver goldfish, specimens with fins in odd, abnormal positions, partial albinos—are segregated during the sorting. In all the millions of fish which have crossed the sorting tables at Grassyfork, Capt. Wood told me, no perfect albino has ever appeared.

The greatest freak in goldfish history, and also the most valuable specimen ever seen in America, was the famous Liberty Bond fish exhibited during the World War. Red, white and blue, it was used to attract crowds during the Liberty Loan drives of 1917 and 1918. Its owner valued it at $10,000. The price of the fish raised in Martinsville runs from a nickel apiece, for small common goldfish, to $25.00 apiece, for the relatively rare Moor telescopes. *(Continued on page 109)*

RAISING GOLDFISH BY THE MILLION

(Continued from page 108)

Where do they sell all their millions of fish? Who buys them? Those are questions almost every visitor wants to know. Nickel and dime stores, pet shops, department stores, carnivals, chain stores, drug stores, florists—these all are regular customers. In addition, unusual sales add to the total.

FOR INSTANCE, not long ago, a wood-treating plant in the middle west sent in a hurry call for a thousand goldfish to eat up mosquito larvae in the standing water of the treating tanks. New Jersey and other states also buy fish as part of a program of mosquito control. Indiana purchases thousands of uncolored fingerlings to feed growing bass in state hatcheries.

Most goldfish that fail to live in captivity are killed by pampering. Their needs are few and simple. Let me pass on a dozen tips offered by the men at Grassyfork for keeping your pets in good condition.

1. Don't overcrowd them. In the aquarium allow a gallon of water for every inch of fish, not counting the tails.

2. Don't change water too often. Once every six months is sufficient. Occasionally dip out a gallon or so and replace it with fresh water of the same temperature. Such water should be allowed to "ripen" in the room for twenty-four hours before being poured into the aquarium. If this is not possible, sprinkle a pinch of salt in it.

3. Never shift fish to water that is hotter or colder than that in the aquarium. Violent changes in temperature injure them. The correct thermometer reading for a goldfish bowl is between sixty and seventy degrees Fahrenheit.

4. Don't overfeed. This is the commonest cause of trouble. Never place more food in the bowl than can be consumed in twenty minutes.

5. During the winter, cut the amount of food in half. Fish are much less active then and three feedings a week are plenty.

6. When your fish "cluck" at the top of the water, it is a sign they need more oxygen. Hot, thundery days and dark winter ones are the times when the goldfish most need extra oxygen. Plants such as sagittaria, eelgrass and ditchmoss add oxygen to the water and should always be growing in the aquarium. Oxygen-forming chemicals are available for aquarium use and an electric-driven aerator, which washes and warms the air before pumping it into the water, is on the market for large aquariums.

7. If you use city water, check up on the chemicals being put in it. Chlorine is deadly to goldfish. It breaks down the gill tissue just as lye would do. A fish injured by chlorine can never be restored to health.

8. Never fertilize waterplants in a pool with manure. It adds toxic acids to the water and injures the fish.

9. At spawning time, remove all snails from the aquarium. They eat the eggs. You never have little fish without waterplants in the pool. The older fish eat the eggs unless they have vegetation to protect them.

10. Once a month add a pinch of Epsom salts to the water in the aquarium. It acts as a laxative and helps keep the fish in good condition.

11. Keep your aquarium in a light part of the house. Fish need sunshine; they do not do well in dark corners.

12. Watch the fin on a fish's back. It is his health barometer. When it begins to droop, the fish is ailing; when it is erect, the fish is well. Oftentimes, placing a sick fish in a mild salt bath for several days, or feeding it finely chopped bits of earthworm, will restore it to health.

SUIT-CASE TRANSMITTER EASILY BUILT

(Continued from page 67)

connection clip along the voltage divider resistance (R4) until the buffer milliammeter (0-200) barely shows a reading of one or two milliamperes. The bias for the final stage can be adjusted in the same way.

While anyone of the various types of transmitting antenna systems can be used with this outfit (P.S.M., Aug. '32, p. 65), a single length of wire and a good ground will serve when the unit is used as a portable. Simply connect one side of the antenna coil to the antenna; the other side to the ground.

The problem of tuning the transmitter to the exact band when the buffer is acting as a doubler will be simplified by using a wavemeter of the type recently described (P.S.M., Sept. '32, p. 54). Under actual operating conditions, the crystal stage should draw about forty milliamperes, the buffer about sixty milliamperes, and the final approximately 150 milliamperes.

Remember, short-wave transmitters can be operated only by amateurs who have passed the Government radio license examination. However, lack of a license need not prevent you from constructing this transmitter. If you plan to get a license eventually, start building it now and you'll be ready to go on the air when your license arrives.

WHAT THE LETTERS ON CIRCUIT DRAWING MEAN

R1—Fixed resistor, metalized, 15,000 ohms.
R2—Fixed Resistor, metalized, 50,000 ohms.
R3—Variable resistor, 10,000 ohms, 25 watt.
R4—Voltage divider, variable, 25,000 ohms, 50 watt.
C1—By-pass condenser, .002 mfd.
C2—Midget variable condenser, 100 mmf.
C3—Fixed condenser, .00025 mfd.
C4—Variable condenser, 100 mmf.
C5—Midget variable condenser, 100 mmf. reduced by double spacing to 11 plates.
C6—Variable condenser, 100 mmf.
C7—Electrolytic condenser, 600 volts, 8 mfd. (in series).
C8—Electrolytic condenser, 600 volts, 8 mfd.
C9—By-pass condenser, .002 mfd.
C10—Variable condenser, 100 mmf.
L1—24 turns of No. 18 cotton-covered wire on 1¼-in. diameter form.
L2—23 turns of No. 18 cotton-covered wire on 1¼-in. diameter form, center-tapped.
L3—23 turns of No. 16 enamelled wire on 2¼-in. diameter form, center-tapped.
L4—23 turns of No. 16 enamelled wire on 1¼-in. diameter form.
RFC—Radio frequency choke, 2½ millihenries, grid-leak type.
Ch1—Filter choke, 20 henry.
T1—Power transformer, 750 volts each side of center tap.
T2—Filament transformer; two 7½-volt windings, one 2½-volt winding, and one 5-volt winding.
T3—Power transformer, 375-volts each side of center tap; also one 2½-volt winding and one 5-volt winding.
MA—Milliammeter; one 0-50, one 0-200, and one 0-300 range.
X—Indicates position for 0-1.5 radio-frequency antenna ammeter, if used.
Xtal—Crystal and holder. (For either forty or eighty meter band.)
Sw—Toggle switch, 110 volts.
J—Jack and plug (for key).
Six 4-prong sockets.
Two 5-prong sockets.
Three type '10 tubes.
One type '47 tube.
Two type '83 tubes.
Miscellaneous—One portable case (wood frame suit case will serve), key, solder, wire, insulators, key, etc.

MICROBE HUNTING WITH A MICROSCOPE

(Continued from page 44)

size, and the fact that many of them carry buds that are of the same general shape but smaller in size. Like bacteria, yeast cells collect in strings; but frequently these strings are branched, and some of the individual cells exhibit branching buds of smaller size. In bacteria strings, the individual plants are of about the same size, and are not branched.

THE botanist will tell you that bacteria are the smallest and simplest living things known, consisting of single cells whose protoplasm seems to be organized hardly at all. It would require 50,000 of some of the ball-shaped bacteria to extend one inch. This means that each bacterium measures about the same as a wave length of green light, so that it can just be seen by the microscope.

While some germs cause deadly fevers, others live in the roots of plants and manufacture nitrogen so necessary to plant growth. For every germ that grows in spoiled food and manufactures a poison so powerful that mere tasting of the food may cause death, there is a tiny organism that is working on waste animal and vegetable material, reducing it to a state where it becomes a useful part of the earth again, ready to start once more on a cycle in which it will serve as part of a living plant or animal.

Some bacteria live in the air for at least part of their lives, while others cannot exist in the presence of oxygen. All bacterial forms reproduce by simple fission. That is, one of the cells splits across the middle to form two new individuals. Sometimes these cells hang together until long strings of them, such as you saw in the saliva of your mouth, are formed. Others produce a jellylike material that binds the individual germs into masses or colonies which when conditions are right, become large enough to see with the unaided eye. A common way of identifying or studying bacteria in the laboratory is to cultivate them in colonies and then observe the color of the colony, as well as the shape and other characteristics of the individuals forming it. When conditions for growth are unfavorable, a bacterium may secrete a tough shell that encloses it, thereby becoming a spore. Some spores are so resistant that they can be boiled in water for hours without causing the death of the encased individual.

Doubtless you have heard the story of how a single bacterial cell, provided with all the food necessary, would grow in a few days into a living mass larger than the earth. Of course this can never happen, but you can prove that it might, by calculating how many individuals would be produced in a week by a species whose individuals divide every half hour, assuming that none of the germs die.

IN GENERAL, bacteria are shaped like balls or like rods. They may be equipped with one or more cilia or hairs. The rod forms may be bent and twisted like corkscrews.

Because illumination is one of the most important things to consider in connection with the microscope, you may be interested in construction of a laboratory-type lamp. This form of illuminator is used widely and is valuable for photomicrography and microprojection. You can build it for about one tenth of what you would pay for a ready-made lamp of similar characteristics.

The lamp consists of a 108-watt bulb in a housing that is *(Continued on page 111)*

MICROBE HUNTING WITH YOUR MICROSCOPE

(Continued from page 110)

fitted with a sixty-millimeter spherical condenser for concentrating the light on the microscope slide. The lamp operates at six volts and consumes eighteen amperes of current. That means that a transformer must be used to step down alternating current, and a suitable resistance used for direct current.

ASSUMING that you have a six-volt source of current available, your problem is to combine the bulb and condenser into a convenient microscope accessory. The photographs illustrate a form of lamp that was determined largely by the materials at hand.

The lamp house is four and one-half inches square and seven inches high. It was made by a tinner from scrap monel metal. Almost any other kind of sheet metal would do just as well, although a material that requires no painting is preferable. The bottom of the house is open and the top is equipped with a simple lid held in place by two nickeled bolts that engage slots in bent-over parts of the lid. Vent holes are drilled near the top, in the sides and rear only.

The tubular bulb is held in a heavy-duty aluminum-shell socket that is mounted in the approximate center of a square piece of sheet metal. This piece has the edges bent over for a distance of one-half inch and drilled to receive four bolts that pass through slots in the sides of the housing. The slots permit up and down adjustment, for centering the filament. The socket has a threaded shade holder that acts as a nut for holding it in the sheet-metal piece. The hole in this piece is somewhat larger than the socket, and washers are used to overlap it.

The condenser is a sixty millimeter short focus spherical lens designed specially for microscope work. It retails for about $2.50. It must be mounted in a tube that can be moved back and forth for focusing. The tube in the lamp illustrated is an old adjustable camera-lens mounting that happened to be available. The lens flange was bolted over a hole cut in one side of the lamp house and centered approximately with respect to the filament.

THE base of the lamp is an eight inch sanding disk (with the sandpaper removed) of a type sold for home-workshop use. The short piece of steel shafting that extends up from the center of the disk is equipped with a ball-and-socket photographic tripod head that permits the lamp to be tilted as desired. In use, the bulb should be kept as nearly vertical as possible. The wires carrying current to the bulb are asbestos-covered fixture cord, doubled because of the heavy current: that is, ends of a two-wire cord are twisted together to form a single conductor, and two such cords are used.

If desired, a filter holder and water cell for absorbing heat can be attached to the lamp, at the outer end of the lens tube. The filters should be not less than two inches square. Special micro filters in gelatin form can be purchased and mounted between sheets of glass, (P.S.M. Nov. '33, p. 44.) The water cell consists of two parallel pieces of clear glass separated a short distance and mounted so that water can be held between them.

The bulb employed is known as the 108-watt, six-volt type, and can be obtained through most electrical dealers. It can be obtained with a single-coil vertical or horizontal filament or a ribbon-type filament. The vertical coil is the cheaper, and is satisfactory for practically all amateur work.

Actual cost of the illuminator illustrated was in the neighborhood of seven dollars, not including the transformer. It does the work of a ready-made illuminator costing around forty or fifty dollars.

Secrets of Success

STORIES THAT WILL HELP YOU GET AHEAD

OIL BURNER BUSINESS STARTED IN DESERT

ALASKAN sourdoughs this winter are warming themselves beside an oil-burner made in the Mohave desert. And cheaply, too. The heart of the burner, a little pyramid-shaped casting, not much larger than a mousetrap, costs only a few dollars. It fits inside any old stove. A few gallons of inexpensive distillate, and there you are—all set for a tough winter.

But "Made in Mohave"—there's the story. Another very modern instance of the old saw that the world beats a path to the door of the man who builds bigger and better mousetraps.

John Beyers is the man. He went to the desert to raise pears. And pears—perhaps you've heard—pears have not been doing so well these last few years. In fact, many a rancher has ended the shipping season owing his broker money, instead of the other way around—getting a nice fat check for his crop. You can't keep that up very long.

Beyers soon was in the position of many others, of seeing visions of the notorious wolf peering around the trunk of every tree in his thirsty orchard. It costs money to irrigate in the desert. It looked like a cold winter ahead. The rancher retired to his workshop to give the matter a little thought.

The Mohave freezes up in October and usually celebrates May Day with a good hot fire to keep the chill out of the breakfast-room. Many a ranch-house diary, too, records a flurry of snow in June. Of course, next day the thermometer goes up to 110°, but that's another story.

YOUR winter's fuel supply in the desert is something to put wrinkles in the brow. Coal is at a premium because of freight charges. Discarded railroad ties are not as plentiful as they used to be. And there is no native tree, except the Joshua, which, if it isn't full of water, is as dry and quick-burning as gunpowder.

John Beyers decided to do something about it. The result was the little cast-iron mousetrap that now is filling with a cheerful glow many a snowbound Alaskan cabin. It is that simple.

The first casting he made in his own workshop. It didn't work worth a hoot. It burned too slowly. The stove sooted and so did the chimney. There wasn't enough draft.

A vacuum *(Continued on page 113)*

Secrets of Success

OIL BURNER BUSINESS STARTED IN DESERT

(Continued from page 112)

cleaner hooked in reverse in front of the stove, naturally, would overcome that difficulty. But that, of course, began to get into the upper-price brackets. There were plenty of expensive oil-burners on the market. This, to be a success, must be cheap.

A couple of lengths of stove-pipe on top of the chimney took the place of the mechanical draft, and the Beyers' Burner was ready to go on sale.

Throughout that first winter, the rancher manufactured the burner in his workshop and made his own installations. Satisfied customers did his advertising. The business grew.

Now the castings are made in quantity at a city foundry and—well, if they are already selling in Alaska, business must be pretty good. Better, anyway, than paying your broker for the privilege of growing pears.—F. D., Mojave, Calif.

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EARTHQUAKE OPENED UP NEW BUSINESS FOR HIM

A CONSULTING geologist living in Southern California found himself with little or no funds, and without a job, about the time of the Long Beach earthquake of March 10th, 1933. He managed, however, to get a temporary job on one of the various commissions which investigated the causes of the earthquake and its effect on building construction.

This job did not last very long and the man in question found himself once more unemployed, but he had learned something and had gotten an idea. He had discovered that the great majority of people in the earthquake area were crassly ignorant of the scientific causes of earthquakes and he got the idea of presenting the means of understanding the fundamentals of the science of seismology through some simple, yet workable seismograph which could be easily erected almost anywhere and which would cost but a nominal sum to build and keep up.

He realized that he was tackling a big job, due to the fact that there was only one seismograph on the market and that particular machine cost in the neighborhood of $500.00. Furthermore, it took an expert to operate it. He spent six months in intensive in- *(Continued on page 114)*

Secrets of Success

EARTHQUAKE OPENED UP NEW BUSINESS FOR HIM

(Continued from page 113)

vestigation of the feasibility of the proposition and finally, after repeated failures, devised a simple recording machine, scientifically known as a horizontal electromagnetic double pendulum seismograph.

His machine costs less than ten dollars to install and practically nothing to maintain. It will record surprisingly well, all local tremors as well as world shaking earthquakes, of which he states there are about 61 each and every year. The machine in question was at first sold to friends who, finding so much constructive enjoyment in its use, quickly recommended it to others among which are many prominent people, including some film stars who have commissioned this geologist to erect his machine on their estates. He, of course, gets quite a tidy sum for such a special job.

He is finding an ever expanding market for his machine throughout not only Southern California, but in the earthquake areas of New Mexico, Texas, and Nevada. At present, he is experimenting on a more accurate device and expects to branch out into foreign countries which are subject to earthquakes such as Central and South America, New Zealand, and Japan. This is the story of one man who pulled himself out of financial depression by using his knowledge in a unique way.—J. S. M., Inglewood, Calif.

Cash Prizes

THIS department will give $5.00 for every true success story submitted by readers of Popular Science Monthly, and which is accepted for printing in this magazine.

Manuscripts will be judged on the individual merits of the case and circumstances involved. Only stories in which the author's success, or that of some one known to the author, has been gained by some method of educational guidance, fitness for the job, or application to the work will be considered. We are not looking for the "get-rich-quick" type of story.

Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

Always mention POPULAR SCIENCE MONTHLY when answering advertisements in this magazine.

HERE'S THE ANSWER

(Continued from page 64)

exactly 100 pounds, more than 100, or less? —L. H. G., Milwaukee, Wis.

A.—THE catch in the question hinges on the words "uniformly accelerated." If the boy's feet were resting on a scale, the pointer would read more than one hundred pounds, the amount depending on the acceleration.

Floating Power House

O. B. H., WILLARD, O. The *Normandie*, the world's largest and newest electric ship, is 1,020 feet long, has a beam of 117 feet, and measures 202 feet from mast tip to waterline. Its motors are capable of developing more than 160,000 horsepower.

Airplane Brakes

R. B. M., PROVIDENCE, R. I. Airplane brakes generally are controlled by the pilot's feet. Each brake working independently of the other, they serve two purposes. Both can be applied for stopping, or one brake can be used to swing the plane around sharply when taxiing.

Cleaning Razor Strops

H. A., GLENS FALLS, N. Y. Razor strops can be cleaned by rubbing them with alcohol or a weak solution of ammonia water. To polish, rub them with clean tallow.

Alligators vs. Crocodiles

E. J., TAMPA, FLA. No hard and fast rule can be used to distinguish the crocodile from the alligator. In most cases, however, the alligator has a blunt, square nose while the snout of a crocodile is long and pointed, the head forming a triangle. Of the twenty-two types of crocodilians, only two can be classed as alligators—one being found in North America and the other in China.

Man's Third Eye

Q.—WHAT proof is there to bear out the belief that man at one time had a third eye in the top of his head?—L. M., Atlanta, Ga.

A.—IT IS the pineal gland, a nervelike construction located in the brain, that is thought by many scientists to be the remains of a third eye. Such auxiliary eyes have been found on many fossil lizards.

Preserving Flowers

M. R. E., MIAMI, FLA. One way to preserve flowers is to dip them in melted paraffin which has been heated just enough to make it a liquid. Freshly cut flowers also can be preserved by immersing them in a solution of twenty grains of salicylic acid, ten drops of formaldehyde, two ounces of alcohol, and one quart of distilled water.

Faster Than Fastest Man

R. L. T., SPOKANE, WASH. Nerve impulses in the human body travel about ten times faster than the fastest human—roughly about 404 feet a second.

Nothing to Do With Trade

Q.—WHAT are the trade winds and how did they come by their name?—M. Q., Los Angeles, Calif.

A.—LIKE lead pencils that contain no lead, trade winds have little to do with commerce. They get their name from the old English definition of the word meaning "straight path." Being air currents directed toward the equator by the rotation of the earth, they often follow the same course for long periods without changing.

HOW ASTRONOMERS MEASURE THE SIZE OF THE DISTANT STARS

(Continued from page 55)

ment is based in our modern observations.

Set up the mirror with the single vertical scratch near a frosted electric bulb. Then hold the other two mirrors together so that the single horizontal scratch crosses the two vertical converging scratches near where they meet.

Then look through the two tiny holes, formed where the scratches cross, at the vertical scratch on the standing mirror near the lamp. You will see an image of the slit showing the hairlike vertical stripes. Watch these stripes carefully while you slide the mirror with the horizontal scratch downward over the other mirror.

AS THE lines on the mirror diverge, the holes formed by their crossing the line on the other mirror become more and more separated. As these holes separate, the hairlike vertical stripes get closer and closer together until they finally disappear, leaving the image of the slit clear white. In other words, the light waves coming through the two holes no longer interfere.

This is the principle upon which star measurement with the interferometer is based. Another simple experiment with a small telescope will show how the principle is applied.

Make a narrow slit, a few thousandths of an inch wide, in a sheet of black paper, and support it vertically in front of a bright light. Your frosted bulb will serve again. Set up the telescope, magnifying twenty or thirty times, on a tripod about forty feet from the slit. Then prepare a cap, made of Bristol board, to fit firmly over the telescope's object glass. It is constructed so that the distance between two one-sixteenth-inch holes can be varied by sliding a strip of card to left and right.

Focus the telescope on the illuminated slit in the black paper and observe it with the cap off. It appears as a narrow band of even white. Then put the cap on with the holes as close together as the cardboard slide will allow. Observe the slit again. You will now notice the hairlike parallel lines in the image of the slit, due to the interference of the rays from the two holes in the cap.

Then move the cardboard slide in the cap so that the one-sixteenth-inch holes move farther and farther apart. Move the slide until the interference lines finally disappear. Now measure the distance between the holes in the cap, and divide this distance by the wave length of light (about 1/50,000 of an inch). The result is the angular width of the slit in the black paper. Accordingly, since its distance from the telescope is known, the slit's actual linear width may be calculated by trigonometry.

In measuring the distance of a star, the same procedure is followed, but instead of holes in a lens cap, the interferometer is a long steel girder with forty-five-degree light-collecting mirrors. In the case of the star, the angular width that it occupies is so small that a very powerful telescope is required, fitted with two light-collecting mirrors very far apart. In the latest interferometer, recently completed at the Mount Wilson observatory, the mirrors (equivalent to the holes in our lens cap) are fifty feet apart.

SINCE there is no telescope with an object glass fifty feet, or even twenty feet, in diameter, the rays from the light collectors are bent down at right angles into a smaller telescope mirror by two additional forty-five-degree mirrors.

The diagram shows graphically why the image of a star, say Betelgeuse, no longer shows the interference stripes when the holes of a telescope cap are moved sufficiently far apart.

First look at the left-hand sketch in that diagram. Two waves, A and B, start earthward from points on opposite sides of Betelgeuse. Each of the wave fronts is a circle, but by the time they reach the earth their curves are so large that they are practically straight lines, lying at right angles to the lines along which they both advance. Accordingly, since lines from opposite sides of enormous Betelgeuse must converge in order to reach the tiny earth, the two wave fronts, a-b and b-a, must cross each other at the point x and diverge by the same amount in both directions.

But the holes of the interferometer cap in our left picture are so close together that the wave fronts, a-b, and b-a, are diverging by less than half a wave length when they pass through the two holes and enter the telescope lens. Accordingly, the interference pattern (1), when added to the pattern (2), at the focus of the telescope, still shows interference lines. The dark stripes of (1) do not cancel out the light stripes of (2) because their combined wave fronts are less than half a wave out of step.

NOW turn to the right-hand sketch in the same illustration, in which the holes in the lens cap have been separated until wave fronts a-b and b-a are diverging by exactly half a wave when they pass through the holes. The result is that all the black stripes of (1) exactly cancel out all the bright stripes of (2), giving a clear white field.

When the interference bands of Betelgeuse vanish, the distance between the holes in the cap is measured, and divided by the wave length of light. This gives the angular width of Betelgeuse, and since its distance is known, the actual diameter of the star can be calculated by trigonometry.

The sizes of some of the stars, as given by measurement with the interferometer, are almost beyond human comprehension. Imagine a great globe of fiery matter, large enough to take in our sun and the entire orbit of the earth (186,000,000 miles in diameter) and leave over 30,000,000 miles all around. This gives an idea of the size of Betelgeuse, one of the bright stars that mark Orion's shoulders, as measured by the interferometer. It is 250,000,000 miles through. Contrasting with this is Sirius, the brightest star in the whole sky, but having a diameter of only 1,900,000 miles, a little over twice the size of our sun.

How remarkable it is that the distances of the stars from us are measured by the light-year, a yardstick so enormous that the mind becomes dizzy imagining it, and their diameters are measured with a unit so tiny (the wave-length of light) that it can not be seen at all without a microscope.

METEOR OVER CANADA TURNS NIGHT INTO DAY

A METEOR so bright it outshone an air beacon is reported from Canada. Streaking across the sky at terrific speed, it lighted up the landscape around Saskatoon with almost a noonday brilliance before it disappeared in an explosion which is thought to have blown it to dust. One motorist mistook the fast-moving light for an approaching car and swerved into the ditch. A hundred miles from Edmonton, houses were rocked by the explosion and at Bashaw, citizens rushed from their houses when the night suddenly turned into day. The light, brilliant greenish in hue, was described as more intense than the rays from the municipal airport beacon at Calgary. The shooting meteor was visible from Helena and Great Falls, in Montana, according to reports from those cities.

SAFER LANDINGS FOR SWIFT PLANES

(Continued from page 23)

shortened run after the big machine has landed.

The N. A. C. A. has conducted flight tests of the autogiro type of aircraft. These tests show that a ship of this type coming down for landing in a fairly steep glide at an air speed of thirty-six miles per hour drops fifteen feet per second, which compares favorably with the rate of vertical descent of planes of the usual type in glide landings. But in a straight-down descent the autogiro's vertical velocity is thirty-five feet per second—considerably faster than is considered advisable for comfortable landings.

Fire, although not nearly so common as unfortunate landings, remains a serious hazard in the air. During the period between January, 1931 and June, 1933, there were in the United States forty-one fires in airplanes in flight, and 118 planes caught fire after crashes. Fire-extinguishing systems have proved valuable, but it would be better to avert the danger than to fight it.

THE flash point of aviation gasoline—the minimum temperature at which its fumes will ignite—is thirty degrees below zero. In the recent past several fuels with much higher flash points were produced experimentally, but none of them developed the same power as does gasoline.

Recently the N. A. C. A. tested a new safety fuel—a hydrogenated gasoline—that seems likely to take most of the fire hazard out of flying. Its flash point is 125 degrees Fahrenheit—high enough to remove nearly all of the danger. When gasoline is poured on top of this fuel, and a match applied, the gasoline will burn out without lighting the safety fuel!

Injected into the cylinder of a spark ignition test engine, this safety fuel developed the same power as did ordinary aviation gasoline, and the fuel consumption was only about five per cent higher. It was found to have excellent antiknock qualities. Its most serious disadvantage was that starting was difficult when the engine was cold, but this was overcome by using a little gasoline from a small tank connected with the usual priming system.

The formation of ice on airplanes in flight is another air hazard that is receiving attention. Airplanes encounter their most dangerous ice-forming weather when they are flying through clouds, fog or rain and the temperature is within a few degrees of freezing. In such weather planes often are forced down in fifteen or twenty minutes, and seldom can keep the air for more than an hour.

Tests made on models in the refrigerated wind tunnel at Langley Field have proved that coating the wings with various suggested compounds is almost useless. Corn syrup was found to be the most effective substance, but it washed off too quickly to be of any great practical use under service conditions.

The most successful device for combating the ice peril so far developed is an "overshoe" which, when needed, can be attached quickly to the leading edge of the wing. It is made of light weight rubber fabric impregnated with an oil mixture. Inside the overshoe is a reënforced rubber tube that is alternately inflated and deflated by an air pump controlled by the pilot. Any ice is thus lifted and loosened, and then blows away by the rush of the air over the wing. It seems probable, however, that the ultimate solution of the problem will be the heating of the front part of the wings.

LANGLEY FIELD flight tests of an experimental heating system were very encouraging. A full-scale model of part of a wing was mounted on a plane. A small boiler, filled with a mixture of water and alcohol, was inserted in the exhaust pipe. The steam was carried along the front edge of the wing by a pipe in which there were a number of small holes, through which the vapor escaped with considerable velocity. After warming the wing, the condensed steam collected at the bottom of its front edge, and was returned to the boiler through a drain pipe. Many tests were made under ice-forming conditions, but no ice formed on the experimental wing.

In planes of all-metal construction—and most of the planes of the future will probably be of this type—the wings could be heated by exhaust gases piped directly from the engine. With air-cooled engines, air could be heated by circulating it over the engine, and then supplied to the wings by a fan circulator.

TURNING their thoughts into the future, N. A. C. A. flight scientists are preparing to investigate some of the problems that must be solved before the terrific airplane speeds forecast by progress in plane and engine design can be achieved with safety. One of the most vital of these problems has to do with the vibrations in the structure of the aircraft caused by excessive speed. To measure the now unknown forces that will have to be dealt with as the estimated maximum 500- to 600-miles-per-hour speed limit of the airplane is approached, another wind tunnel must be added to the dozen now in use at the Langley Field Laboratory.

This new tunnel, on which work will be started as soon as the $478,000 it will cost is made available, will be a unique and gigantic piece of scientific apparatus. Fireproof and free from vibration, it will be 154 feet long, fifty-one feet wide, and twenty-five feet high. It will have a maximum air speed of 500 miles per hour—a velocity so great that the watcher will actually be able to see the disturbed air rush past the test models. Its walls will be built of reënforced concrete lined with steel plates. Eight thousand horse power will be needed to drive the fans that will send the mighty blast of air across the test chamber eight feet in diameter in which large-scale models may be tested.

In this new wind tunnel will be solved many of the flight problems of the future.

RESEARCH SHOWS SPICES ARE AID TO DIGESTION

UPSETTING the old idea that spices and condiments are bad for the health, researches reported from Hungary indicate that they are an actual aid to digestion and the assimilation of food by the body. Taken in moderation, two scientists at the University of Debrecen discovered, spicy food stimulates the action of the villi, microscopic protruberances of the membrane which lines part of the digestive tract. Their activity has an important influence upon the completeness with which foods are digested. Speeding them up, cuts down the time required to carry foodstuffs from the digestive tract into the body fluids and make it available for use by the cells.

TURNIP JUICE FAVORED FOR VITAMIN STRENGTH

TURNIP juice has taken its place beside orange juice and tomato juice as a health drink containing the scurvy-preventing vitamin C. Dr. E. W. McHenry, of the University of Toronto School of Hygiene, in Canada, recently pointed out that one cent will buy 1100 vitamin C units in the form of turnip juice while it will buy only 220 in orange juice and 170 in tomato juice.

FEATS OF MAGIC FOR THE HOME CHEMIST

(Continued from page 61)

flame. When the material is heated, it is then touched with a drop of cobalt nitrate and again heated. If the mass becomes blue (Thenard's blue), the presence of aluminum is indicated. On the other hand, if a green color (Rinman's green) results, zinc or one of its compounds is present.

Free nickel or cobalt can be produced in small quantities in the home laboratory by simply heating a mixture of cobalt or nickel compounds and sodium carbonate (soda ash) on a charcoal or asbestos block. Prepare small quantities of the metals in this way and place them in a test tube. Then hold a strong horseshoe magnet near the sides of the tube and you will be surprised to find that the powders retrieved from the fused mass in each case will be attracted. Strange as it may seem, both cobalt and nickel are magnetic.

IT IS this magnetic property of cobalt that makes possible the manufacture of cobalt steel alloy, a metal displaying a higher magnetic strength than any other steel. The great magnetic properties of cobalt steel are illustrated graphically by the floating magnet shown in the photograph. The device, arranged by the Westinghouse Electric Company, consists of a metal ring that floats mysteriously in the air above an innocent-looking composition base. The secret lies in the use of cobalt steel. A permanent magnet of cobalt steel is cleverly hidden in the base while the floating ring itself is made of the same metal. The combination of the repelling forces of like poles holds the floating ring away from the base, suspending it in the air. No other steel exhibits such strong magnetic qualities.

Metallic cobalt also can be obtained by immersing a bright strip of magnesium metal in a solution of cobalt nitrate. The cobalt will be precipitated on the strip in the form of a greenish powder which, when washed and dried, appears black. In testing, you will find that a magnet also will attract this prepared form of cobalt. Similarly, by adding zinc dust to a nickel-chloride solution, free metallic nickel will be formed. It, too, will display strong magnetic properties.

Although there is nothing startling in the statement that iron is magnetic, many amateur chemists will be surprised to learn that iron hydroxide also will exhibit magnetic qualities. This interesting compound can be prepared in the home laboratory by adding a half teaspoonful of ordinary hydrogen-peroxide solution (3%) to a somewhat dilute solution of ferrous ammonium sulphate. Several drops of strong sodium-hydroxide solution then should be added and the iron hydroxide will be precipitated in the form of a light brown powder. Finally, shake the tube and rest it close to the poles of a permanent magnet. When the iron hydroxide precipitates and settles, a quantity of it will tend to adhere to the glass nearest the magnet.

FEW chemicals have a more high-faluting name than the cobalt compound known as cobalt hydromercurithiocyanate. Although the chemical has no practical uses, the colors disclosed make its production an interesting experiment for the home chemist.

To prepare the chemical, add a solution of ammonium, sodium, or potassium sulphocyanide (thiocyanate) to a solution of mercuric chlor.. and place it in a tall container such as an olive bottle. Then add a solution of pinkish cobalt nitrate. In a short time, a flaky blue precipitate will fall gently through the liquid, slowly settling to the bottom. This precipitate, resembling a blue snowfall, will be the cobalt hydromercurithiocyanate, which when washed and filtered, can be preserved.

TALES SPARK PLUGS TELL ABOUT MOTORS

(Continued from page 68)

the trouble you are having in the engine.

"On the other hand, spark plugs in another car may show an accumulation of dry soot down near the points. Generally that means a mixture that's too rich. You can check it by holding your hand in front of the exhaust after the motor has been running awhile. If it smells strongly of gasoline, it bears out the spark-plug symptom."

"I've always thought that a badly carbonized spark plug meant only one thing," said Barret. "And that's a worn piston and rings."

"ONLY when it's oily," said Gus. "If the plug is dry, the heavy crust of black carbon may be caused by any one of a number of different things. Bum timing, a broken connection, a low battery, poor breaker points, and leaky valves all can contribute to the carbon on a plug. If the rings are bad and oil is being pumped into the cylinder, the plugs are bound to be fairly wet and gummy.

"Generally, leaky pistons and rings will give themselves away by fouling the plugs almost as fast as you can clean them. If one or two cylinders particularly act that way, it's a safe bet they're pumping oil."

"I had a funny thing happen to me about a year ago," interrupted Barret. "Took my plugs out one day to clean them and adjust the points and found that the tips on two of the insulators were cracked. What do you suppose caused that? The motor seemed to run fine when I put in new plugs."

Gus grinned. "Chances are you caused that trouble yourself. Good plugs seldom crack inside a motor unless it overheats. You probably made the mistake of bending the electrode that's embedded in the porcelain instead of the one that's joined to the metal shell. Naturally, you're going to crack the insulator if you put any pressure on it. Once it's cracked, it's only a question of time until carbon finds its way in and short-circuits the plug."

"There's more to these spark plugs than I imagined," said Barret as he stopped the car in front of the Model Garage. "Except for cleaning my plugs every so often and replacing them now and then, I've never bothered much."

"Well, at least you've been doing the important things," agreed Gus, smiling. "That's more than most folks do. They'd rather save pennies on spark plugs and ignition wiring and waste dollars on gas."

TESTS SHOW BACTERIA SURVIVE INDEFINITELY

NEW evidence that bacteria can survive for illimitable periods has been furnished in tests made by Dr. Charles B. Lipman, professor of plant physiology of the University of California, of soil taken from 800 to 1400-year-old pre-Aztec and pre-Inca pyramids. Three years ago Dr. Lipman discovered living bacteria in the interior of anthracite coal and last year he reported finding bacteria in meteorites (P.S.M., April '33, p. 42). His discoveries have led Dr. Lipman to conclude that bacteria can survive in a state of suspended animation for millions of years.

ALTITUDE FLYERS NEED CARBON DIOXIDE SUPPLY

AVIATORS flying at high altitudes should take along a supply of carbon dioxide as well as a tank of oxygen, recent investigations at Hamburg, Germany, have shown. Many of the ill effects of high altitudes are now overcome by the use of oxygen but the recent tests have shown that other effects are due to a lack of carbon dioxide in the blood.

BREEDING DOGS FOR GREATER BRAINS

(Continued from page 35)

a brain weighing 1,000 grams is as likely to be an intellectual giant as is a large man with a brain weighing 1,800 grams. The human brain is proportioned to its owner's size rather than to his mental capacity.

It is the same with dogs. The weight of their brains varies from thirty grams or less for the little fellows to 150 grams or more for the canine giants. A small terrier may be more intelligent than a big St. Bernard—a little mutt smarter than a blue-blooded great Dane. But, Dr. Lentz thinks, in their efforts to "improve" certain breeds of dogs, fanciers may have reduced the width of their heads so much that there no longer is room in them for brains proportionate with the breed's size, with a resulting decrease in the breed's average of intelligence. In recent years breeders of collies, Airedales, fox terriers and German shepherds have succeeded in producing dogs with noticeably narrow heads, and many dog lovers are doubtful if to-day's "stylish" dogs of these breeds are as intelligent as were their more broad-headed forefathers.

WHILE students of the human brain are convinced that the weight of a man's brain has no relation to his mental capacity, their study of the brains of several exceptionally brilliant men and women makes them think that there is a distinct relation between the surface area of the brain and intellectual power. These brains were remarkable for having many more convolutions and much deeper fissures than the brains of less gifted people. In his examination of many dogs' brains Dr. Lentz has found that they, too, vary greatly in the number of their convolutions and the depths of their fissures. This, he thinks, may account for the great differences of intelligence between individual dogs. He points out that the surface of a bird's brain is smooth, but that its lower side—the optic nerve—is so highly developed that it is equal in size to the diameter of the bird's spinal cord. Birds live by seeing. Men—and to some extent dogs—live by thinking!

What makes a dog unusually intelligent?

Three factors, says Dr. Lentz—the same three factors that are responsible for the mentally superior human being. A good inheritance—having intelligent ancestors, although not necessarily ancestors who were blue-blooded members of some particular breed; individual ability; and patient and loving education.

Most dog lovers, Dr. Lentz thinks, put too high a value on blue blood. He likes pure-bred dogs—but he likes them because they are dogs, not because they are English setters or Sealyhams. And he likes dogs of uncertain ancestry every bit as well. After all, a mongrel is just an unplanned crossbreed—and the proud canine who wins the "best in the show" award at Madison Square Garden is the product of crossbreeding many dog generations ago.

BACK about 1850 the ancestors of the now fashionable Airedale were rough and tough waterside terriers, of no particular breed but great killers of rats, in the Aire River district of England. To produce dogs of exceptional fighting ability, some of these terriers were crossed with bull terriers—which were the product of cross-breeding between bulldogs and fox terriers. In a later effort to produce a sporting dog for local needs, the offspring of this crossbreeding were crossbred with otter hounds. The original Airedale that resulted from these experiments was a fair-sized, fast-moving, broad-chested, shaggy-coated customer who could do more than his share of scrapping both on land and in the water. This result having been achieved, crossbreeding was stopped, matings were made for the purpose of accentuating certain physical characteristics, and the modern Airedale—a very different dog from his ancestors—was produced.

The Newfoundland—now coming back into fashion after almost disappearing from the dog-show world—is the result of cross-breeding between Eskimo dogs and various other breeds to produce a husky working dog who could pull a sled, guard a farm in a rough country, and recover gear—and men—washed overboard from fishing vessels.

If two of the most admired of all breeds of dogs are the result of crossbreeding, why look down on the humble "mutt"—who may be quite as good looking if judged by everyday rather than by dog-show standards, and who is every bit as likely to be intelligent and loyal as any of his aristocratic fellow dogs?

INDIVIDUAL mental ability varies almost as widely among dogs as it does among men. If you are keen on having a highly intelligent dog, and you are selecting a puppy, make a point of learning something about the pup's parents—not about their physical "points", but about their intelligence. If both parents are intelligent the pup is likely to develop the same quality, for dog intelligence "runs in the family" in much the same way as does human intelligence.

What develops a dog's intelligence is close association with his master. Dogs that are always kept in kennels seldom show a high degree of intelligence. Dr. Lentz tells of seeing Dobermans in German kennels that fell far below their breed's high average of mental alertness—and of seeing German shepherds that, considered as members of the family circle in country cottages, were so amazingly intelligent that they understood even whispered words, and obeyed the slightest gesture.

To have an intelligent dog, he says, you must be an intelligent master. You must make a real friend of your dog. If you think of him as "just a dog" he will never develop a high degree of intelligence. Never forget that when you get a dog you become responsible for him—that his behavior, as well as his mental capacity and his physical well-being, depends to a very large extent on you.

No one knows just how much of our language a dog understands. Nearly all dogs seem to know the meaning of some words, and many exceptionally intelligent dogs seem to understand a great deal of what is said to them. But it is probable that, except perhaps for a few very simple commands, a dog gets his master's meaning from his inflection, intonation, and facial expression.

DON'T try to teach your dog the meanings of too many words. He'll soon learn what you mean by "up" and "down" and "in" and "out". Make him understand that when you command "heel" you want him to follow you closely wherever you go—and insist that he does it, for it will keep both you and him out of a lot of trouble. Don't be forever ordering your dog to do this or that, but whenever you tell him to do anything take the time and the trouble to see that he does it but always be patient with him.

Be patient in your teaching. Never lose your temper and punish your dog because he has failed to understand what you want him to do. If he understands an order, and then disobeys it, scold him. If he disobeys again, punish him. A folded-up newspaper has every bit as much corrective value as a whip or a strap—and it can't do any damage.

Never strike a dog over the ears—slap him smartly on the side of his mouth. He will accept punishment meekly and contritely, but make very sure never to punish him when he doesn't deserve it. A dog has self-respect; let him keep it!

DOES YOUR PATENT IDEA MEET THESE TESTS?

(Continued from page 41)

for profit contained in the invention.

On the day he received his money and stock in payment for the patent, he offered me a substantial sum in addition to my regular fee. This, of course, I refused. Then, he insisted on buying me a $500 Swiss watch which I still have.

Sometimes when I look at it, I wonder what would have happened if there had been only one or two makers of beds in the country at the time. The fact that there was considerable competition in bed manufacturing and a large number of concerns engaged in that line, enabled Mallet to dispose of his innovation.

IN CONTRAST, take another case. A few years ago, an inventor brought me plans for an antomatic mechanism for producing graphs to show the trend of the stock market. It had a limited number of possible openings at best and after he got his patent the crash of the market left it practically unwanted. The fate of many an invention hangs on the rise or fall of the business with which it is connected. So, test Number Four is:

How sound is the basis of the industry your idea affects?

Shortly after the World War, an American inventor developed a superior type of hairpin and obtained a patent upon it. Then, hardly had it been put upon the market, when the bobbed hair craze swept the country. His idea, which otherwise might have been worth millions, was worth practically nothing, just as ostriches were a drug on the market when women no longer wore ostrich feathers in their hats. Another inventor perfected a new kind of corset just as women quit wearing corsets and a third devised an improved method of distilling whisky just before prohibition came. Now that repeal has arrived, his patent has expired.

Usually, inventions in the field of fashion are among the greatest gambles as regards profits. Fashions may change overnight and a patent which is valuable today may be worthless tomorrow. Again, the value of a patent waxes and wanes as the volume of business in a specific field changes. When automobiles appeared, the demand for buggies dropped. A wise saying among veteran inventors is: Never strive for a patent in a dying field.

On the other hand, it is just as bad to arrive too soon, to make an invention before its time. More than twenty years ago, one of my clients devised an automatic switchboard for telephones. He set up an elaborate demonstration room near Fourteenth Street, in New York City. His mechanism worked perfectly but it was not needed at the time sufficiently for telephone companies to become interested. Now, after his patent has expired, the maze of telephone connections in big cities makes the automatic switchboard a necessity. The lucky inventor is the one who patents a needed invention for an industry which is at its peak.

THERE is always a problem for the inventor when his idea concerns an industry which is expanding rapidly. If he patents his idea at once, it will run out in seventeen years, perhaps just as the industry reaches a point where the invention is beginning to pay. If he delays, keeping silent about his invention, his application may be thrown out for "lack of diligence" in putting it into practice. Or some other inventor may hit upon the idea and apply for a patent in the meantime.

I recall one instance in which two inventors, working independently in different parts of the country, applied for the same patent on the same day, their letters arriving at the Patent Office at identically the same hour.

In this connec- (Continued on page 121)

DOES YOUR PATENT IDEA MEET THESE TESTS?

(Continued from page 120)

tion, a fact which few people realize is that an inventor may apply for and receive a patent upon an idea even after someone else has applied or even been actually awarded a patent upon the same idea. But he usually has to prove beyond all reasonable doubt that he conceived the idea and reduced it to practice before the other man did so and that he was diligent. This usually means a hard and costly battle. The wisest course is to be first in the Patent office.

A few months ago, a New York advertising agency worked out a scheme for selling more ammonia for one of the companies it represented. It decided that by coloring the fluid a bright hue, they could make it stand out on the store shelves and attract the eye of the customer. The plan was tried and immediately the sales dropped to zero. People had been used to seeing ammonia colorless and they thought something was wrong with the colored product. The change was too sudden for them to appreciate all at once.

THE same principle applies to many inventions. They may be sound enough but they do not prove profitable because the public does not take to them. They give the wrong answer to Test Number Five:

Will the change be too sudden for the public?

Probably the easiest kind of an invention in which to interest a manufacturer is an improvement on a widely used device. For example, an improvement in a typewriter would be more welcome than an entirely new kind of writing machine. Manufacturers naturally hesitate about embarking on new ventures but they are usually ready to add an improvement to an established line. The latter costs but a fraction of the former. And Test Number Six is:

How much will it cost to put your idea on the market?

If your innovation is too radical a departure, it may require the scrapping of machinery which represents an investment of hundreds of thousands of dollars and the installation of new machines. Before you approach a manufacturer with such a proposition, be sure your idea passes Test Number Seven, namely:

Is the idea enough of an improvement to warrant installing new machinery or scrapping that already in use?

On my docket, I have data of nearly a hundred patents I obtained for a client on bottle caps. They are all practicable. Only a few were ever manufactured, but billions of those few were sold and are still being sold. The others were not of interest to the manufacturer who had taken pains to build up a demand for the type in use.

While there is a definite group of innovations, called "Talking-Point Inventions", which have little real value and are used simply to provide salesmen with talking points, such ideas are usually produced by employees of the companies and not by outsiders. When you have an idea, look it over and be sure it represents a real improvement and not just another way of doing something.

SOMETIMES, even though your idea is superior to anything on the market, it may fail to prove profitable because it cannot compete in price. The Eighth and final test is:

Can your invention compete in price with rival products?

Take the recent case of an inventor in Canada, who devised a method for keeping sleet and snow from windshields. His idea was the placing of electric heating wires between the layers of the shatterproof glass. This was done at the time of manufacture and was rather expensive. Although the idea was a good one, it had no chance of making money after another experimenter turned out a small wire heating unit which could be attached to the outside of the glass and which could be manufactured so cheaply it sold in ten-cent stores.

Unless your invention is so superior that its merits are easily seen, the chances of its sale are small if its cost exceeds that of similar products now on the market. Experience has shown that it is easier to sell a million articles at a profit of one cent apiece than a hundred thousand at a profit of ten cents apiece. So if your device can find a place in five- and ten-cent stores, its chances of bringing in profit are usually excellent. When the price exceeds five dollars, salability drops rapidly.

YOU probably have heard stories of how sudden flashes of inspiration have produced valuable inventions. Cierva, the inventor of the autogiro, for instance, thought of the idea which made that aircraft a success as he was watching a play in a Madrid theater. Henry A. Wise Wood, noted for his work in the realm of printing presses, has had some of his best ideas just as he awakes in the morning. A third experimenter reports his inspirations come most frequently while he is taking a bath; a fourth while he is listening to a sermon in church. It is important to note, however, that in every case the flash solves a problem upon which the men have been working for a long time. They first decided what was needed and what would prove profitable if they could invent it. Then they set out to overcome the obstacles in the way.

A plan for helping inexperienced beginners to confine their efforts to inventions which are in demand has been suggested by a well-known inventor, whose proposal is quoted in Joseph Rossman's "The Psychology of the Inventor." His scheme is to establish a government board composed of experts from every line of industry. Any citizen who discovered something or who had an idea for an invention could present it to the board in secret session and could be advised whether it was worth following up or should be abandoned. Although he would not have to follow the board's decision, he would have the benefit of its advice. Thus, the proponent of the plan points out, inventors might be saved years of effort and millions of dollars.

However, it is not likely that this plan will be adopted in the near future, if it is adopted at all. In the meantime, the best guide I know for gaging the demand for an invention and its probable worth are the eight tests mentioned at the beginning of this article.

Before you go to the trouble and expense of completing and patenting your idea, give it these eight tests. They will go far in helping you to avoid blind alleys that lead to disappointment.

TELEVISION MAY ADD TO POWER OF TELESCOPE

VIEWING the stars by television is the means proposed by Dr. Francois Henroteau, Canadian government astronomer, as a means of peering farther into space than the eye or camera can see. Instead of a photographic plate, he would place a mosaic of tiny photo-electric cells at the focus of a telescope and connect them electrically with a television viewing screen. The cells, more sensitive than the photograph emulsion, would detect stars observable in no other way. Tests with a model have convinced Dr. Henroteau that a small telescope can thus be given a power equivalent to that of a 2,000-inch reflector. The largest existing telescope uses a 100-inch mirror.

SPLIT - SECOND DECISIONS SAVE MOTORCYCLE SPEED DEMONS

(Continued from page 29)

struck the fence I was out, apparently for the evening. The ever-present ambulance, which proved balky, was pushed over to where the body lay and I was loaded for a quick run to the hospital. Before we arrived I had regained consciousness, and when the machine refused to pull up a hill, I climbed out and helped push it on to my own bedside.

ONE of the oddest accidents took place at Long Beach when Lamoreaux drifted into Miny Waln forcing him against the crash wall. Miny lost his machine. The crowd could not see it, as it disappeared completely from view. Not until Lammy reached the next curve did it reappear when he broadsided and not one, but two motorcycles looped in the air. Miny's motor had hooked onto the right handlebar of Wilbur's machine and, try as he might, he could not shake it loose.

Fate is not always kind, however. In one scratch race, Bo Lisman brought us across the pole very fast, probably forty-five miles an hour. As we hit the curve, Bo broadsided, with Byrd McKinney and Jack Miln following in that order. I was on the outside, which sometimes is an advantage, and I tried to make the best of the position by broadsiding ahead. I threw the motor practically sideways, cutting across the track, and got ahead of Jack; but in moving up I spun completely around against the crash fence, with Jack gunning his motor for all he was worth. He hit me, doubled me up like an accordion and I was shipped home to Fresno with two broken vertebrae.

I turned over my two JAPs, which are English-made machines in use the world over, to Burton Albrecht. He upheld my trust by riding the curves so fast he gave all the others the jitters. Then one night, Burton went into a curve from a flying start the same way I did when I broke my back. He and Cordy Milne locked handlebars. The crash threw Cordy fifteen feet and a wheel knocked several teeth out when his motor landed on him. Burton and Pete Coleman finished the race, but it was decided to re-run the event. Most boys would slow down a little after such an experience, but Burton rode even faster in the second heat to take first place.

The JAPs have taken speedway honors consistently in all countries where races are held. These are a single-cylinder machine of considerable power. Recently Al Crocker and P. A. Bigsby brought out at Los Angeles the first American built night-speedway racing motor to challenge the British product. Jack and Cordy Milne were first to ride the Crocker specials—and they swept the boards. In two November meets, the lithe, slim Cordy took nine first places and three seconds in twelve starts, while Jack was first six consecutive times in nine starts. This season sees the debut of the second American made speedway machine, the Harley Davidson. Tests made last winter indicate it will also be very fast.

ALL the more successful riders use motors specially built for flat-track racing. Some have built up their own jobs. These look very pretty, make a lot of noise, and finish somewhere near the rear. I have noticed homemade motors on all the American circuits, but all of them act much like an outlaw bronco trying to run the Kentucky Derby. Even the best riders cannot handle an unwieldy mount, for somehow they either are thrown or finally crack into a fence.

The first essential, oddly, is not the motor, but rather a controllable and rideable frame. After I pick out my frame, I begin to think about engine speed and performance. But not until I had full control of my power skids was I able to control high speed. No one can learn to slide on a contraption he cannot control.

Appropriate riding apparel is especially necessary, both for appearance and safety. We are, first, actors roaring around a small stage, beneath lights as brilliant as those which actors face across the footlights. Second, we are speed demons who must think of our own safety. I never ride without adequate leather clothing, a cork-lined crash helmet, steel ribbed boots, heavy knee pad and a reliable steel toe cap for the left foot. Should I fall when not wearing these protective contrivances I'd be sure to bruise my knees or legs; possibly not serious injuries, but bad enough to prevent remounting and continuing the chase for the elusive prize money.

Crash helmets have saved more than one rider from certain death. Slim Meyers and Wilbur Lamoreaux collided on a Los Angeles track one night. Meyers unloaded and was struck by Lamoreaux's pedal on the top of his helmet, tearing a hole almost down to his skull. The hard fiber outer skin, the layers of cork and wool and cotton softened the terrific blow. Meyers escaped with a bad shaking. Lamoreaux bounced against the crash wall, striking his mouth on the edge of the fence. He lost several teeth and but for his helmet would have suffered a concussion of the brain.

For years speedway racing had been popular in several foreign countries, but it was not until 1929 that the sport was introduced at the Breakfast Club track in Los Angeles. From a modest beginning it took hold rapidly, particularly in the West, and last year races were run in seven California cities, as well as San Antonio, Dallas, New Orleans, New York, and a few other spots.

New A. M. A. tracks are in operation in Chicago, and other midwestern cities. These speedways are created on strictly scientific lines. We have found from experience that a track which will withstand the terrific onslaught of the motors, particularly on the turns, must be constructed of three layers.

The top three inches is a cushion, sometimes cinders or decomposed granite, or it may be the native soil, which permits sliding the rear wheels. Only in this way is broadsiding possible. This cushion is dragged back onto the track after each heat.

Under this cushion lies an intermediate layer which combines workability with hardiness. It is about eight inches deep and must permit frequent turning over and rebonding. This is the layer on which the motors loose their savage energy when the rear wheels bite through the cushion as we fight for the pole on the turns. On the proper upkeep of this layer lies the difference between close, fast power skids and a scattered race in which the riders string out into a long and unexciting line.

The lowest stratum has the hardness of concrete and measures about ten inches in depth. This usually is a combination of soil and rocks, though a hard soil sometimes serves the purpose. Such a combination is necessary to permit watering before the races, thus to prevent the audiences being showered with dust and cinders, and, more important to us who brave these turns, to slide around without losing our motors.

San Diego Speedway in San Diego, Calif., was the first speedway in the United States to be constructed purposely for the new motor-cycle sport. V. A. and Edw. W. A. Seward were successful in compounding a track at San Diego that has withstood the pounding of a full season. From their efforts much was learned which *(Continued on page 123)*

SPLIT-SECOND DECISIONS SAVE SPEED DEMONS

(Continued from page 122)

has since been put into practice on other durable and fast tracks.

Almost as soon as we began to race at San Diego, we found the track took punishment in four places. The triple radius design was employed on the curves, resulting in four complete and nearly right-angle turns being required while travelling nearly fifty miles an hour. On these sharp corners the damage resulted.

COMING down the finish line, we angled for the pole as we went into the first bend. We broadsided. Across the short end, which might be termed a forty-foot straight-a-way, we sped, only to angle for the pole on the second bend, where we broadsided again before straightening out in the back stretch. This procedure, of course, was repeated on the opposite end of the track.

As soon as a slight groove appeared on any one corner all the riders would fight for it as it helped hold us in close to the pole. Repeated use deepened the groove and, due to the fanning of the rear wheels, it soon developed into a hole. The only way to prevent this serious development was found to be watering the track four times before the night's racing, thus actually building a base of water down to a depth of six inches. Fifteen minutes before the races start the track is dragged, thus working the soaked top into a fine cushion.

Water may enable us to avoid spectacular sweeping slides which send a shower of dust into the air, but it makes possible faster, and more dangerous, racing. I guess that's what the public wants.

GHOST SHIP IS ADRIFT IN THE ARCTIC WATERS

AFTER floating for a year and a half, the derelict Hudson Bay fur steamer, *Baychimo*, has been sighted near Point Barrow, Alaska. It was trapped in ice near Wainright in September 1931 with $600,000 worth of furs on board. Airplanes from Nome rescued passengers, crew, and part of the cargo, before a heavy storm broke and the ship disappeared. A few days later Eskimos sighted it and a trapper removed $35,000 worth of furs before the vessel disappeared. The ship was not seen again until April, 1932. Then it disappeared until it was sighted again off Point Barrow a few months ago. Other derelicts have drifted for years, menacing navigation, before they sank. One, the American schooner *Myer G. Sargent*, drifted back and forth across the Atlantic three times before she disappeared forever. Another ghost ship, the *Fannie E. Woolston*, drifted an estimated distance of 10,000 miles, wandering over the Atlantic for three and a half years.

FUTURE HIGHWAY LIGHTS TO BE RADIO SETS

MOTORISTS of the future will speed down highways lined with twenty-foot lights modeled after morning glories from which will come music as well as illumination. That is the vision of Major General George O. Squier, U. S. A., retired, as presented to a recent session of the National Academy of Sciences. The aluminum lamps will be known as radiolites and their form will fit them to act as amplifiers of radio programs which will instruct and amuse the travelers who use the highways. In addition, the morning-glory lamps will be able to diffuse insecticides to kill flying pests along the roadways. During the World War, Major General Squier was in charge of the work of the U. S. Army Signal Corps.

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My Midwest brings in thrilling programs from England, Germany, Australia, Venezuela, Columbia, Argentina and principal world stations. My friends marvel at its tone, sensitivity, power and selectivity. La Rue Thompson, Box 554, Johnstown, Pa.

Byrd Expedition Direct!
My Midwest 16 is best radio I have ever seen. It pulls stations I could never get before. Foreign reception clear as locals. Secured Spain, South America, England, Cuba, etc. Also get Byrd Expedition direct. J.H. Hudson, Loudon, Tenn.

Thrill to Unequalled World-Wide Performance with this -

Amazing NEW 1935 SUPER *Deluxe* 16-Tube ALL-WAVE Radio

9 TO 2,400 METERS (12,000 MILE TUNING RANGE)

30 DAYS FREE TRIAL

Guaranteed WORLD-WIDE RECEPTION!

BEFORE you buy any radio, write for FREE copy of the new 1935 Midwest "Fifteenth Anniversary" catalog. See for yourself the many reasons why over 110,000 satisfied customers have bought their radios direct from Midwest Laboratories . . . and saved from ⅓ to ½. Learn why Midwest radios out-perform sets costing up to $200 and more. You, too, can make a positive saving of from 30% to 50% by buying this more economical way. Why be content with ordinary so-called "All-Wave", "Dual Wave", "Skip Wave" or "Tri-Wave" receivers when Midwest gives you more wave lengths in today's most perfectly developed 16-tube Super de luxe ALL-WAVE radio that are proven by four years of success . . . that carry an iron-clad guarantee of foreign reception! These bigger, better, more powerful, clearer-toned, super selective radios have FIVE distinct wave bands; ultra short, short, medium, broadcast, and long. Their greater all-wave tuning of 9 to 2400 meters (33 megacycles to 125 KC) enables you to tune in stations 12,000 miles away with clear loud speaker reception. Write TODAY for new FREE catalog!

TERMS AS LOW AS $5.00 DOWN

Now, you can enjoy super American, Canadian, police, amateur, commercial, airplane and ship broadcasts . . . and derive new delight and new excitement from unequalled world-wide performance. Now, you can enjoy the DX-ing hobby and secure verifications from more of the world's most distant stations. Thrill to the chimes of Big Ben from GSB, London, England . . . tune in on the "Marseillaise" from FYA, Pointoise, France . . . hear sparkling music from EAQ, Madrid, Spain . . . delight in lively tangos from YVIBC, Caracas, Venezuela . . . listen to the call of the Kookaburra bird, from VK2ME, Sydney, Australia, etc. Send today for money-saving facts.

NEW STYLE CONSOLES
The new, big, Midwest 36-page 1935 catalog pictures a complete line of beautiful, artistic de luxe consoles and chassis . . . in four colors . . . a model for every purse. Hand made by master craftsmen, they harmonize beautifully with any furniture arrangement. Write for new FREE catalog today!

50 ADVANCED 1935 FEATURES

Here are a few of Midwest's superior features: Controllable Expansion of Volume-Selectivity-Sensitivity (Micro-Tenuator) . . . Fidel-A-Trol . . . Triple Calibration Plus . . . Pure Silver Wire . . . Ceramic Coil Forms . . . Separate Audio Generator . . . Simplified Tuning Guide Lights . . . Compact Synchronized Band Switch . . . Amplified Automatic Volume Control . . . 7 KC Selectivity . . . Power Driver Stage . . . 16 Latest Type Tubes . . . etc. Read about these and 38 other features in the new FREE Midwest catalog. Never before so much radio for so little money. Write for FREE catalog.

DEAL DIRECT WITH LABORATORIES

Increasing costs are sure to result in higher radio prices soon. Buy before the big advance . . . NOW! . . . while you can take advantage of Midwest's sensational values . . . No middlemen's profits to pay. You can order your radio from the new Midwest catalog with as much certainty of satisfaction as if you were to select it in our great radio laboratories. You save 30% to 50% when you buy direct this popular way . . . you get 30 days FREE trial . . . as little as $5.00 down puts a Midwest radio in your home. Satisfaction guaranteed or money back. Write for FREE catalog.

SAVE UP TO 50%

Sign and mail coupon . . . or, send name and address on postal card . . . NOW!

WORLD'S GREATEST RADIO VALUE

$57.50 with New *Deluxe Auditorium-Type* SPEAKER

. . . LESS TUBES . . .

We will send you copies of letters like those shown at top of page. They'll convince you that Midwest radios are sensational values! Try the Midwest for thirty days before you decide. Midwest gives you triple protection with: A one-year guarantee, foreign reception guarantee, money-back guarantee.

MAIL COUPON TODAY! FOR AMAZING 30-DAY FREE TRIAL OFFER AND NEW 1935 CATALOG

MIDWEST RADIO CORP.,
Dept. 567
Cincinnati, Ohio.

Without obligation on my part send me your new FREE 1935 catalog, and complete details of your liberal 30-day FREE trial offer. This is NOT an order.

User-Agents Make Extra Money Check Here for Details ☐

Name .....

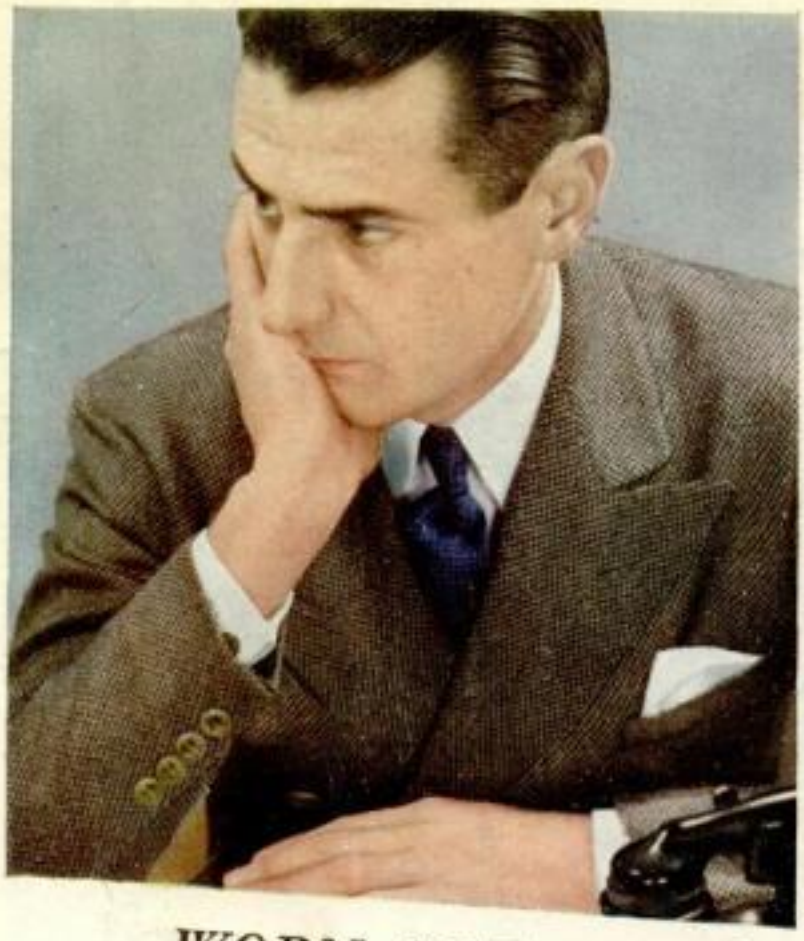
Address .....

Town ..... State .....

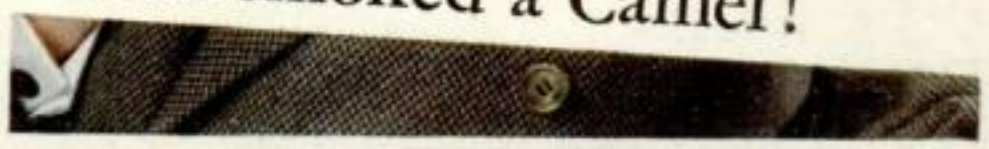
MIDWEST RADIO CORP.

DEPT. 567 — CINCINNATI, OHIO, U. S. A.

Established 1920 Cable Address Miraco. . . . . All Codes



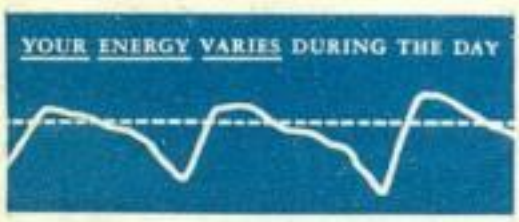
WORN OUT... and then he smoked a Camel!



"DOG-TIRED" AFTER WORK... with a long evening ahead... and dinner time still an hour away! Just one of the many times during the day when you will want to light up a Camel—for restoring your flow of healthful energy. You'll *like* Camels—a matchless blend of costlier tobaccos!

FOUND

Important Facts for Smokers Discovered by Science!



Experience of Camel smokers is now Explained

From a famous research laboratory in New York comes a basic discovery that throws new light on our past knowledge about cigarettes. It embodies an "energizing effect"... a harmless restoration of the flow of natural body energy... a delightful relief from fatigue and irritability. When you smoke a Camel you enjoy an increase in your flow of energy. And this benefit you get from smoking Camels can be enjoyed over and over again... *without upsetting your nerves.*

Let CAMELS increase your flow of ENERGY

Tired? Light a Camel. And as you enjoy its cool, pleasing fragrance, you feel a new flow of energy . . . a quick and delightful "energizing effect."

You've probably noticed this yourself and wondered how it happened. The "lift" you get from Camels is a release of your own *natural* energy... made easily and harmlessly available.

So when you're feeling "all in," smoke a Camel. That tired feeling slips away. Camels have helped your own body to help itself.

You can smoke just as many of these delightful Camels as you want. And you need *never* worry about your nerves. *For Camel's costlier tobaccos never get on your nerves.*

CAMEL'S Costlier Tobaccos never get on your Nerves

Camels are made from finer, MORE EXPENSIVE TOBACCOS than any other popular brand.

"Get a LIFT with a Camel!"